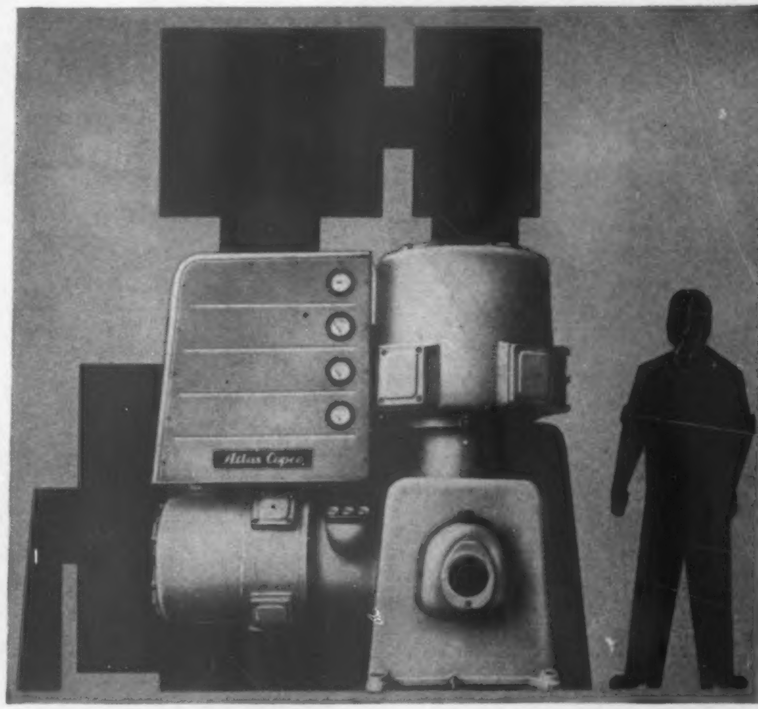
AUTOMOBILE ENGINEER

DESIGN · PRODUCTION · MATERIALS

Vol. 49 No. 3 MARCH 1959 PRICE: 3s. 6d.

New Compressor Design

GIVES OUTSTANDING SPACE SAVING WITH REDUCED RUNNING COSTS



The Atlas Copco ER6 is a new stationary compressor which uses fundamental improvements in design to achieve remarkable results in performance and efficiency. The illustration shows the size of the ER6 compared with a conventional compressor of similar output: yet this extraordinary saving in space is achieved with *added* efficiency and economy, and with the same reliability of operation, which has characterised Atlas Copco compressors for 50 years.

Economy of operation

The specific power consumption for the ER6 is 10-15% lower than for most machines of this capacity range on the market. At 4,000 hours running time per year this means an *annual power saving of up to* £360.

In addition the cooling water consumption of the ER6 is very low because of the special design of the intercooler, amounting to only 440 gallons per hour at 60°F. This is less than half the quantity needed for the majority of other similar air compressors.

PRINCIPAL DATA

Maximum pressure in psi	Speed in rpm	Low-pressure piston displacement in cfm	Free air delivered at 100 psi in cfm	Cooling water required at 60°F approx in galls/hour	Weight in pounds
125	485	1,300	1,075	440	6,600

Economy of installation

The ER6 requires an exceptionally small amount of floor space for its capacity. This reduces the cost of foundation and erection, especially with the use of a flange-mounted motor.

Erection and alignment can be simplified by using a base frame which can be delivered as extra equipment. The balance is so good that the ER6 can be mounted on a skid frame, which does not require a concrete foundation. Skid frame mounting is especially advantageous for contractors and makes it possible for the compressors to be moved easily and at low cost from one site to another.

The ER6 is equipped with an oil pressure control device and cooling water gauges together with a full set of instruments for visual control.

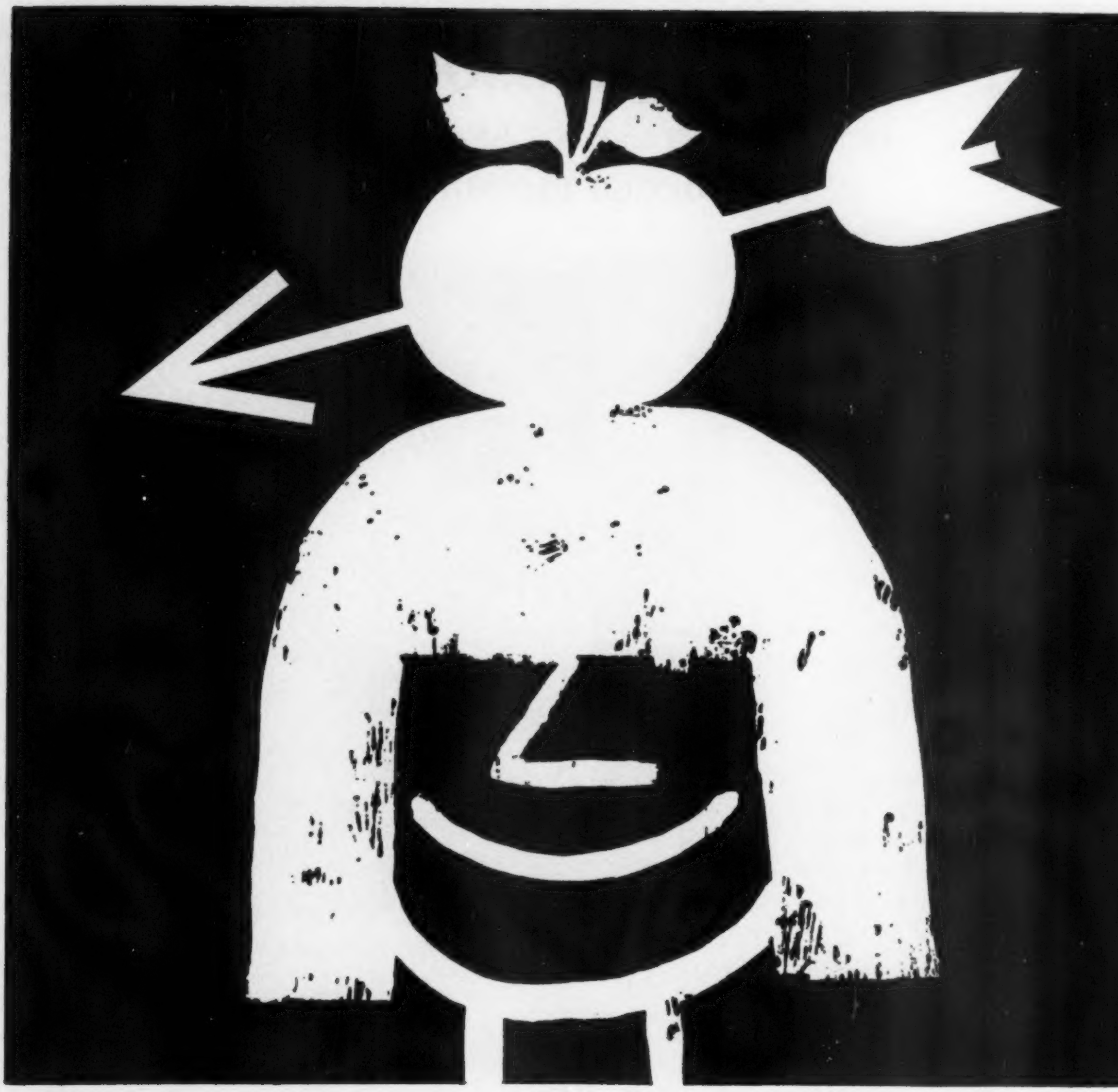
A complete range of compressed air equipment

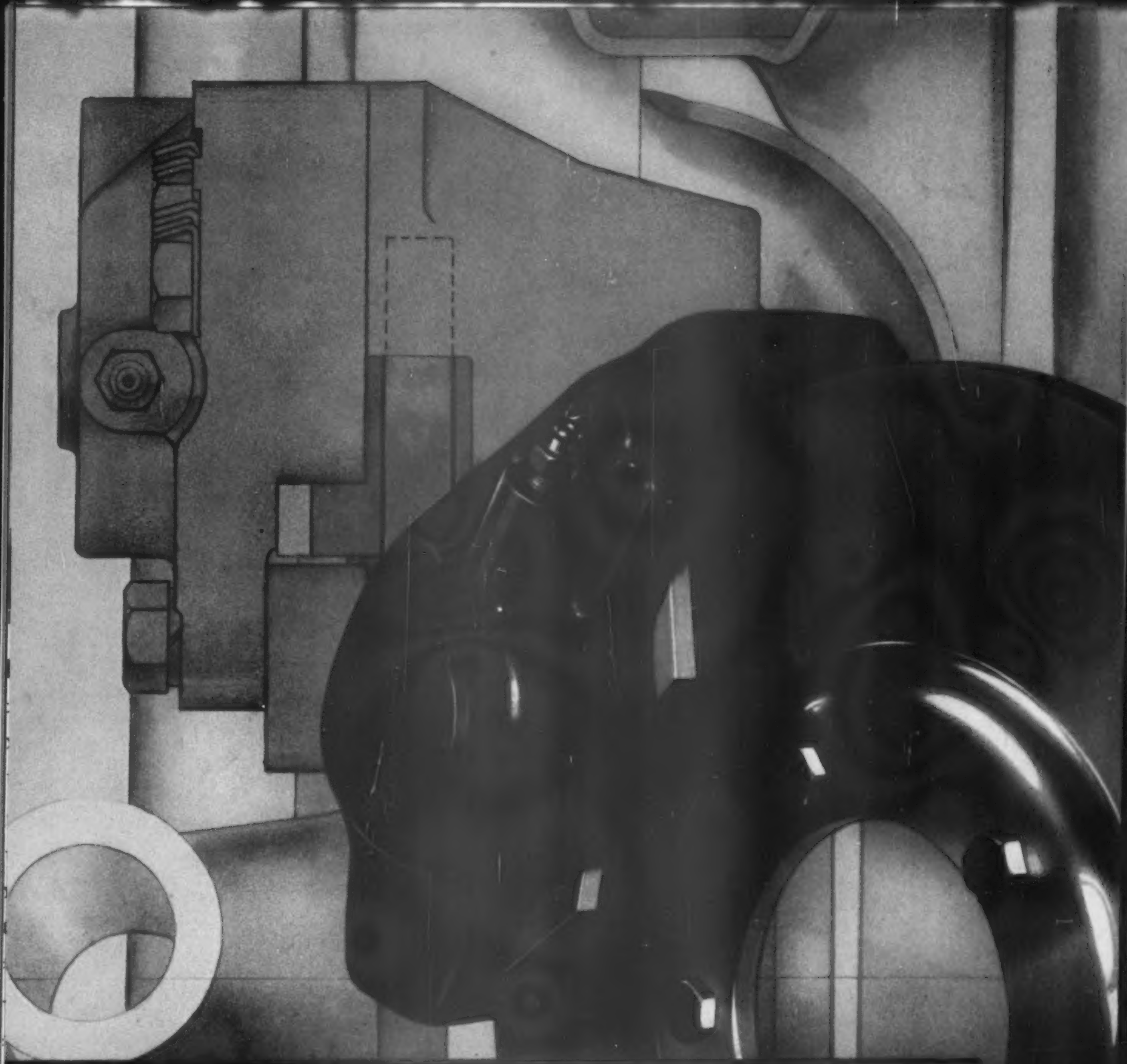
Atlas Copco manufactures portable and stationary compressors, rockdrilling equipment, loaders, pneumatic tools and paint-spraying equipment. Sold and serviced by companies or agents in ninety countries throughout the world.

Atlas Copco PUTS COMPRESSED AIR TO WORK FOR THE WORLD

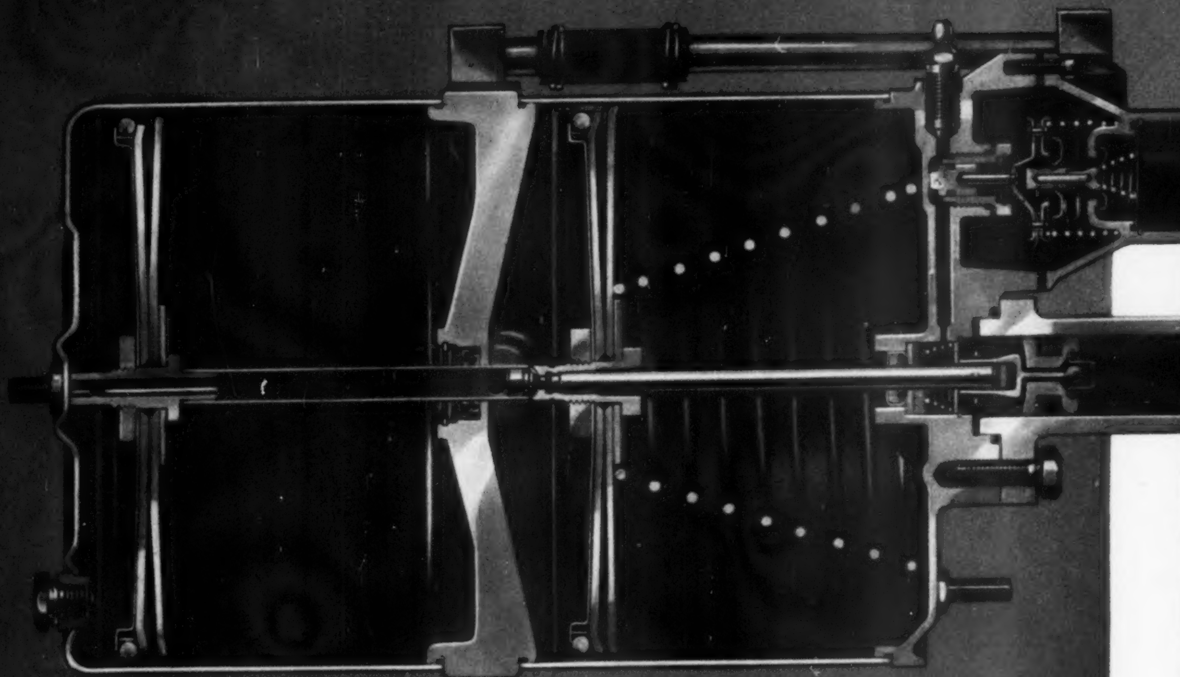
Contact your local company or agent or write to Atlas Copco AB, Stockholm 1, Sweden

C.10-1 G.B.



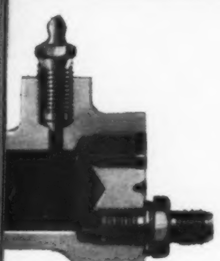


LOCKHEED HYDROVAC SERVO



These units can be used with any suitable hydraulic braking system without alteration to master cylinder or pedal ratio

BRAKING SYSTEMS



For vehicles up to 11 tons

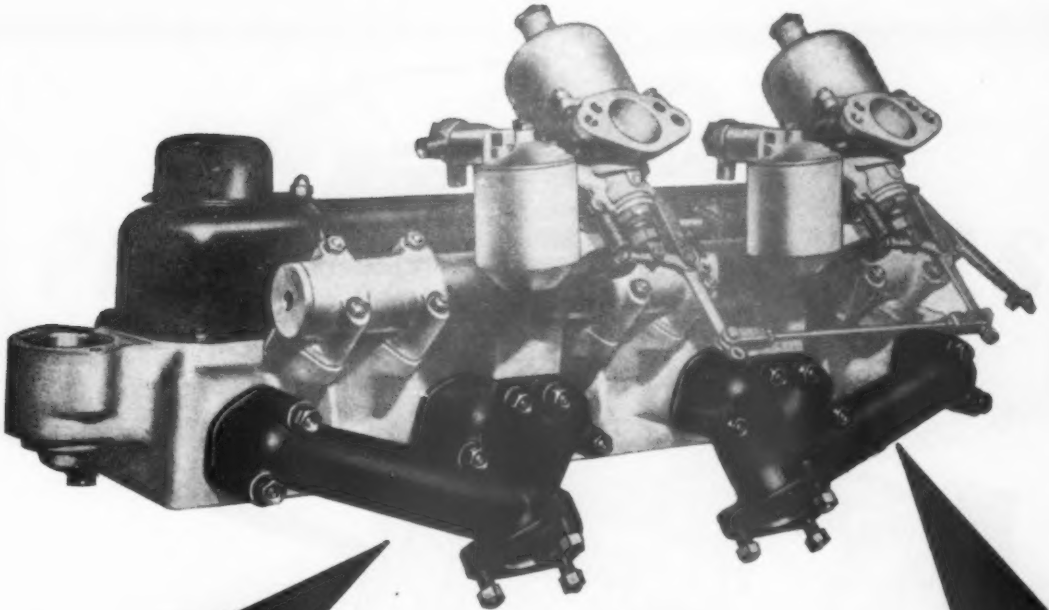
The well-proved Lockheed Hydrovac servo system combines many outstanding advantages over the ordinary vacuum servo, and gives smooth and positive stopping with the minimum effort by the driver.

It can be fitted in any conveniently suitable place on the chassis, all working parts are inside the units with no outside levers, etc. and light brackets can be employed since no reactions are involved.

Hydraulic system retains full efficiency even with servo out of operation. The system is economical of vacuum.

Made in $7\frac{3}{4}''$ single, $7\frac{3}{4}''$ double, $9\frac{1}{2}''$ double. Suitable for vehicles up to 11 tons g.v.w.

LOCKHEED HYDRAULIC BRAKE COMPANY LIMITED
LEAMINGTON SPA · WARWICKSHIRE · ENGLAND



HARPER CASTINGS

play their part . . . .

. . . in the phenomenal performance of the

RAYMOND MAYS ZEPHYR CONVERSION

Rubery Owen & Co. Ltd. chose Harper Castings for the exhaust manifolds of the Raymond Mays Cylinder Head Conversion because of their precision (especially the smoothness and accuracy of the internal passages), their strength and dimensional stability when exposed to hot gases, their freedom from porosity and their ready machineability.

If you require Castings needing any similar combination of physical and mechanical properties, Harper Castings can meet your needs.

The word MEEHANITE is a registered trade mark.

Harper quality covers Grey Iron, Spheroidal Graphite Iron (Mond Nickel Licence) and Meehanite castings. Also Metal Pressings, machining, enamelling and other finishes and sub-assembly work. Also makers of the famous Beatrice Oil Heaters and Harper Housewares.

JOHN HARPER & CO. LTD. JOHN HARPER (MEEHANITE) **LTD.**

ALBION WORKS Phone: WILLENHALL 124 (5 lines) Grams: HARPERS, WILLENHALL **WILLENHALL**

LONDON OFFICE : SEAFORTH PLACE, 65, BUCKINGHAM GATE, LONDON S.W.1 Tel.: TATE GALLERY 0286

MANCHESTER OFFICE: c/o B. J. Brown & Partners Ltd., 248/9 Royal Exchange, Manchester 2

FOUNDED 1790

H 647

METAL CASED OR METAL INSERT SEALS WITH GARTER SPRINGS

Rotary shaft seals for high speeds. Hair line lip contact and correct spring loading ensure minimum friction loss. Complete range of seals for shaft sizes $\frac{1}{4}$" to 10" ex stock. Special seal sections for pressure applications.

PRECISION MOULDED 'O' RINGS

All British Standard and pre-standard sizes ex stock in addition to a large number of non standard and American sizes. Pioneer flash free 'O' Rings are ideal for static or slow reciprocating application over a wide range of pressures.

PRECISION GROUND RECTANGULAR SECTION RINGS

Ground to close limits on the outside diameter, Pioneer Rectangular Rings give perfect sealing on high pressure reciprocating applications.

NU-LIP RINGS

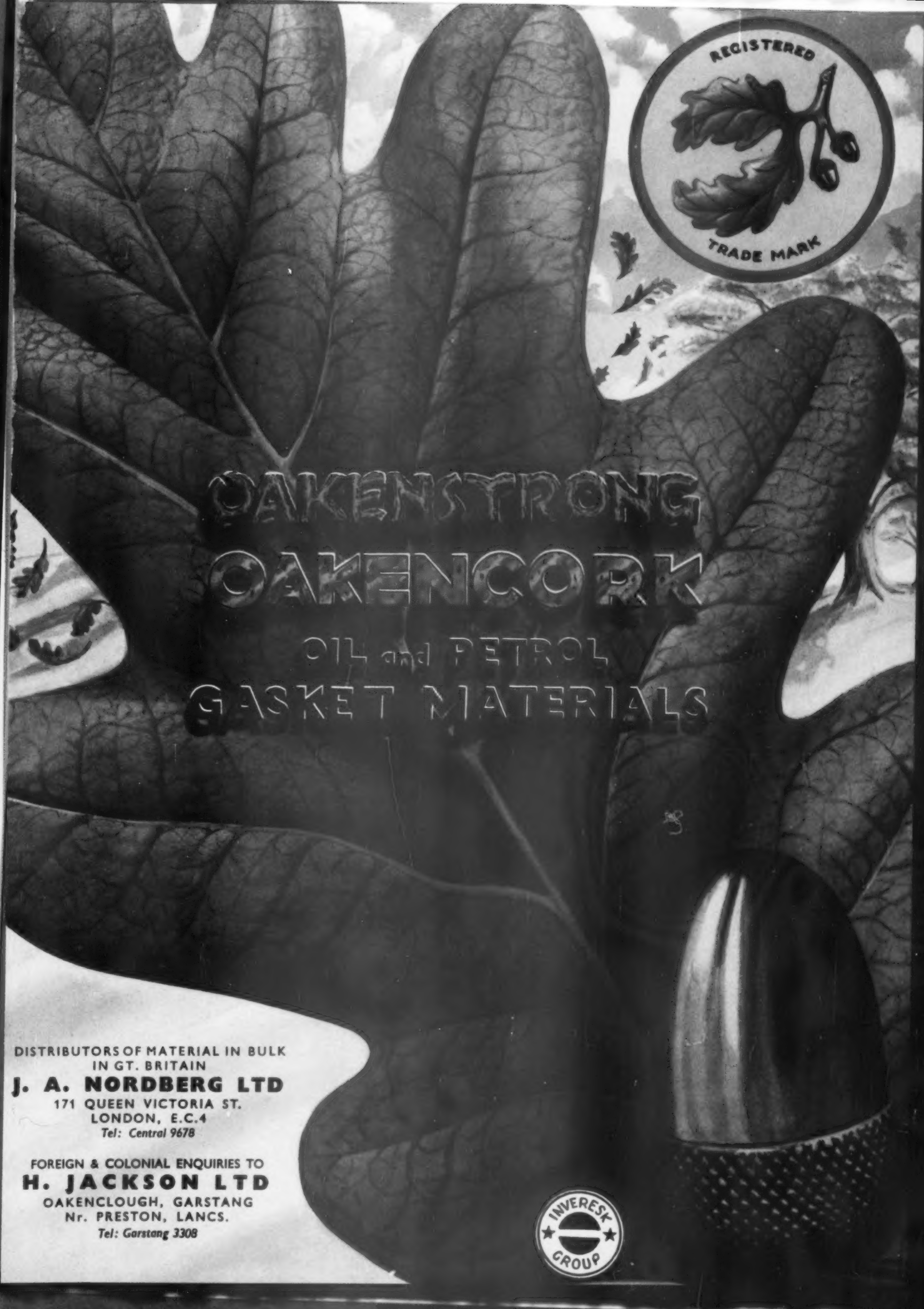
A special section Sealing Ring superior to 'O' Rings or Rectangular Rings on low pressure applications up to 600 p.s.i. Cannot roll or twist in the groove. Hair line contact sealing lips ensure low frictional resistance. Interchangeable with British Standard 'O' Ring sizes.

HYDRAULIC PACKINGS & WIPER SEALS

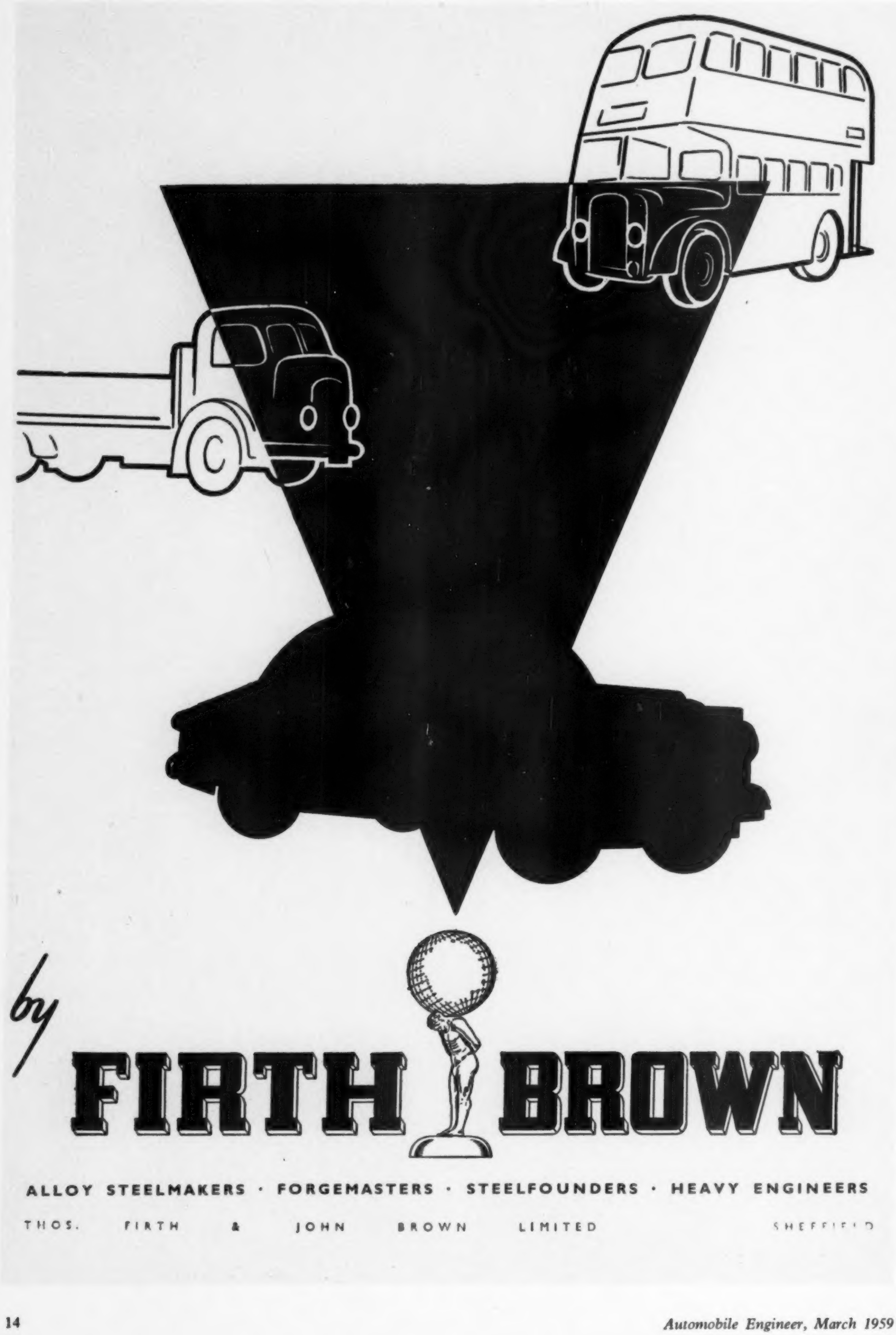
Used as hydraulic and pneumatic Piston Seals, hydraulic cylinder or valve stem packings. Pressures up to 1,500 p.s.i. Six types are available in a wide range of sizes.

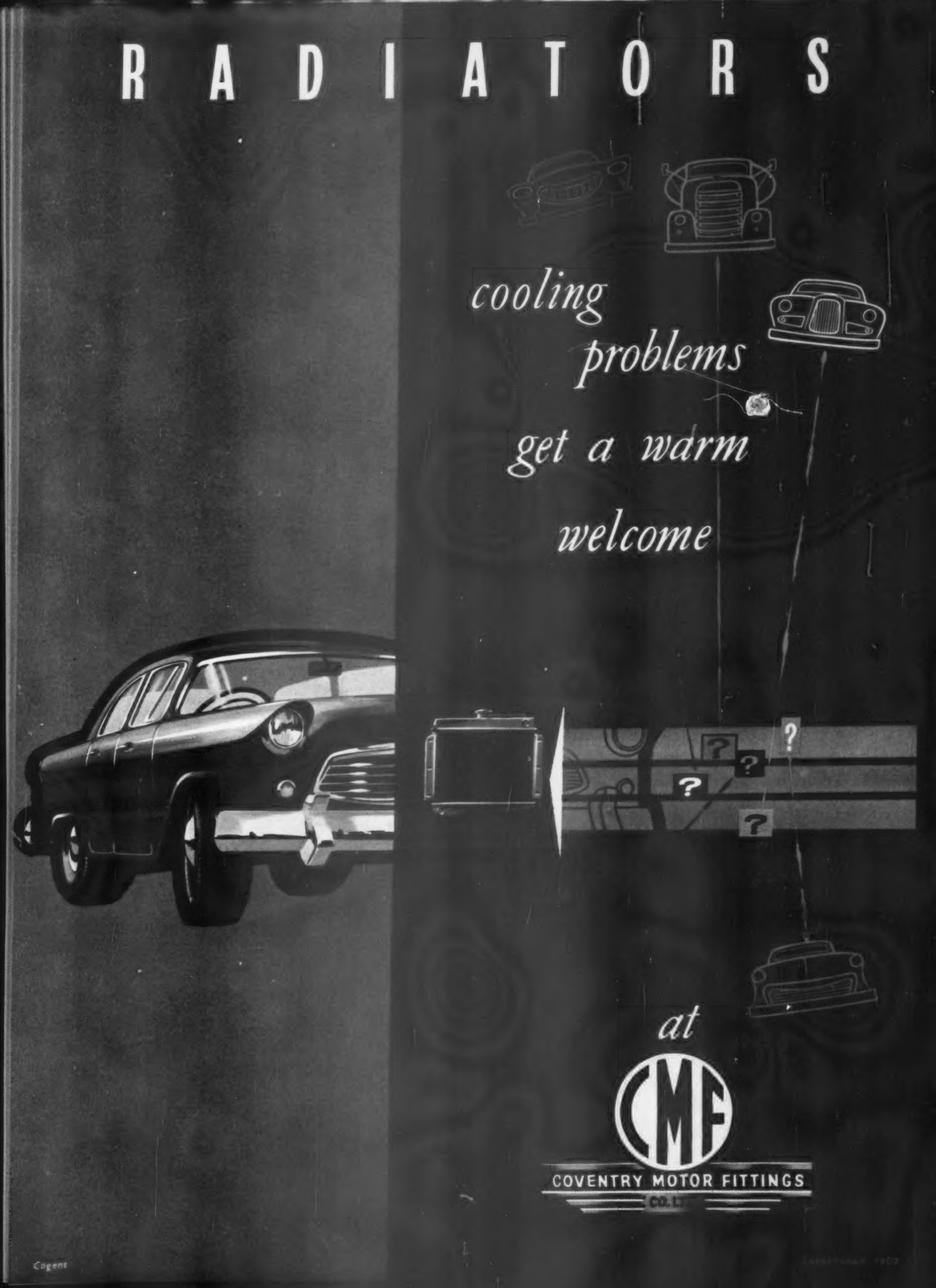
Pioneer Oilsealing & Moulding Co. Ltd.

COTTONTREE WORKS, COLNE, LANCASHIRE. TELEPHONE: WYCOLLER 471 (8 lines)



REGISTERED
TRADE MARK
OAKENSTRONG
OAKENCORK
OIL and PETROL
GASKET MATERIALS
DISTRIBUTORS OF MATERIAL IN BULK
IN GT. BRITAIN
J. A. NORDBERG LTD
171 QUEEN VICTORIA ST.
LONDON, E.C.4
Tel: Central 9678
FOREIGN & COLONIAL ENQUIRIES TO
H. JACKSON LTD
OAKENCLOUGH, GARSTANG
Nr. PRESTON, LANCS.
Tel: Garstang 3308
INVERESK
GROUP


by
FIRTH BROWN
ALLOY STEELMAKERS · FORGEMASTERS · STEELFOUNDERS · HEAVY ENGINEERS
THOS. FIRTH & JOHN BROWN LIMITED SHEFFIELD


RADIATORS
cooling problems get a warm welcome
at
CMF
COVENTRY MOTOR FITTINGS
CO. LTD.
Cogent

SCOOP!

It's powerful, silent and patented! It's the new reversible Desoutter screwdriver—the very first tool to use the Super Atom air motor. Fifty per cent more powerful than even the Mighty Atom motor, without any increase in diameter. Like the new Mighty Atom drills, it's fitted with the popular oil-resisting grip and adjustable silencer/exhaust. More power, less noise, and great to handle! There's not another screwdriver like it. The new Super Atom reversible screwdriver is supplied with lever control handle and suspension bail, as standard. A complete range of interchangeable bits are available. Clutch components and all accessories are interchangeable with existing models.

Type	Speed	Capacity			Weight		
		Wood Screws	Metal Screws				
	rpm		ins	mm	lbs	ozs	kg
2 SA8/2000	2000	No. 6	$\frac{3}{16}$	5	1	12	0·8
2 SA8/1500	1500	No. 8	$\frac{3}{16}$	5	1	12	0·8
2 SA8/1000	1000	No. 8	$\frac{3}{16}$	5	1	14	0·85
2 SA8/500	500	No. 12	$\frac{1}{4}$	6	2		0·9
2 SA8/300	300	No. 14	$\frac{5}{16}$	8	2		0·9

Desoutter

SUPER ATOM REVERSIBLE SCREWDRIVER

Manufactured by Desoutter Brothers Limited, The Hyde, Hendon, London NW9.

CRC 313

what, no nuts? . . .

Nuts to use nuts? Well, not exactly, but the fact that the Tapping Screw obviates the use of nuts is just one of its distinct advantages over the conventional Machine Screw. There's the saving in time to consider too. And cost. And there's no doubt whatever that the tapping screw makes for a better job all round. With its self-locating point the tapping screw forms its own thread thereby eliminating a separate and expensive tapping operation. Obviously it makes for easier assembly, is stronger, cheaper and faster. Safer too when the Phillips recessed head is specified, designed for power driving without damage to worker or job. You'll be well advised to change over to Tapping Screws. Nothing nuts about that !

Linread

LINREAD LTD. COX ST. BIRMINGHAM 3

SLOTTED AND PHILLIPS RECESSED HEAD MACHINE SCREWS AND TAPPING SCREWS • HIGH TENSILE HEXAGON HEAD BOLTS AND SETSCREWS
AIRCRAFT BOLTS, SCREWS AND RIVETS • SEMS • RIVNUTS • CUSTOM DESIGNED COLD FORGED FASTENERS • ALEX SCREWPLUGS

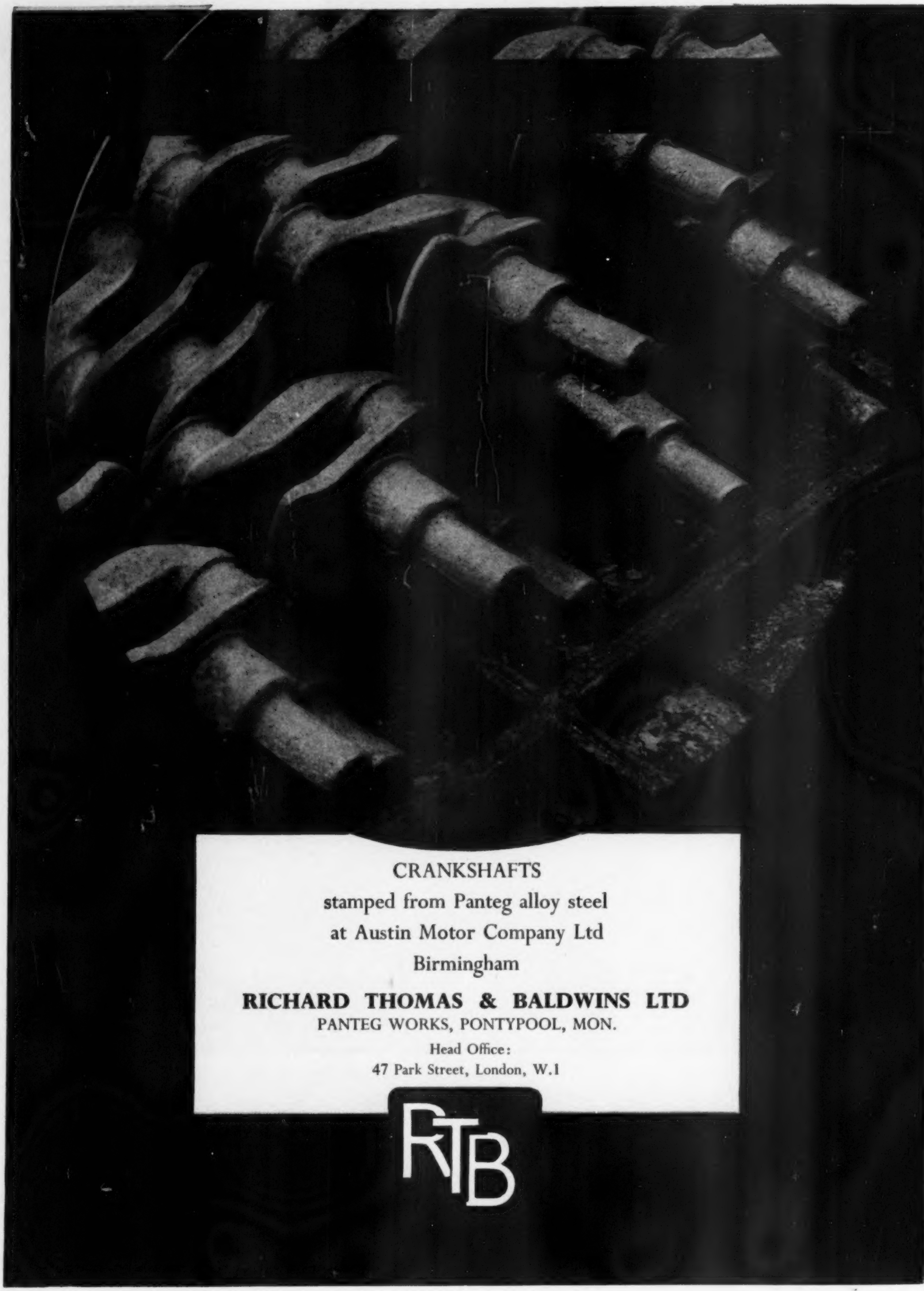
MIDCYL RESEARCH

also helps smooth out problems

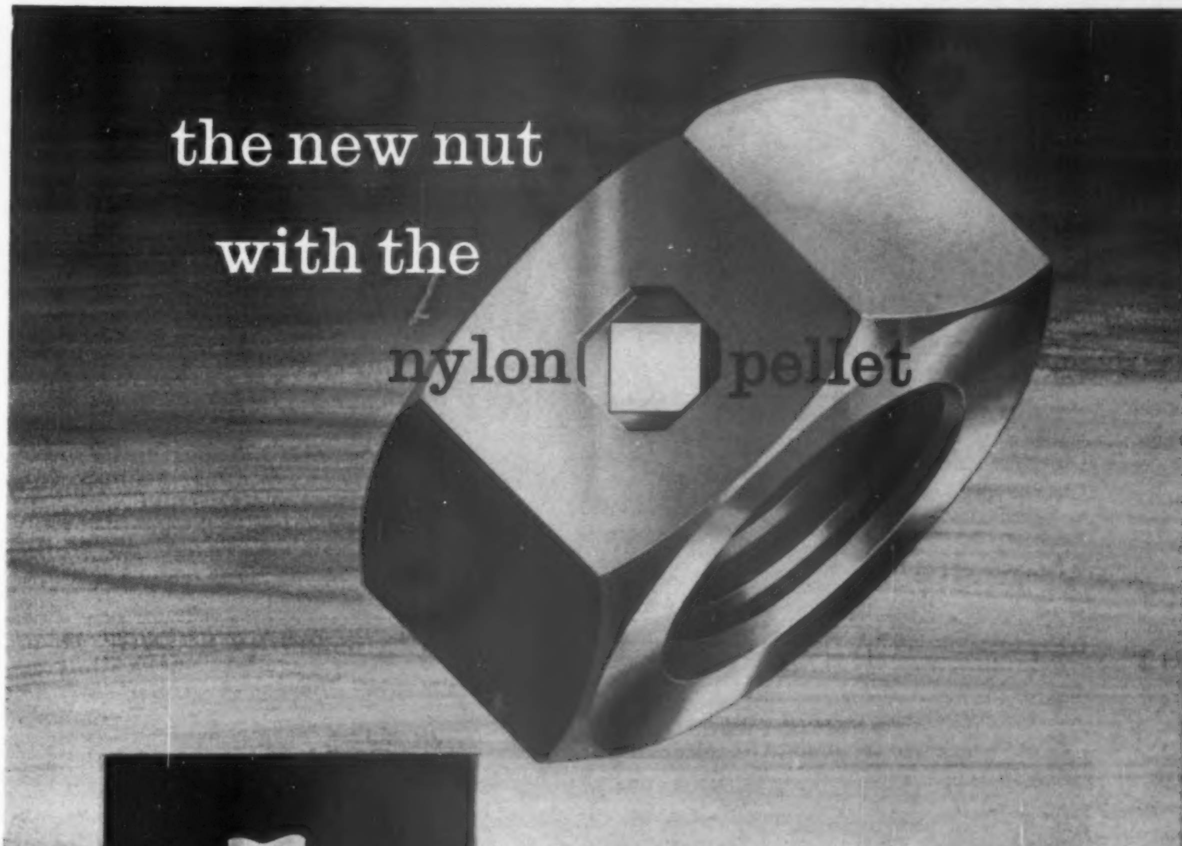
like the potter gently smoothing out his clay, Midcyl research helps smooth the way of the Auto Engineer with such of his problems as are associated with Cylinder Blocks, Cylinder Heads, Camshafts and Brake Drums

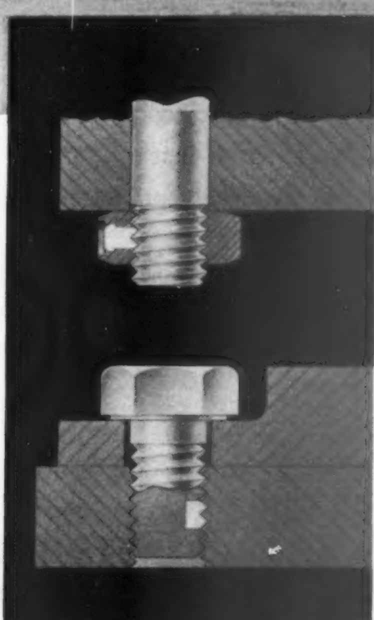
MIDCYL

THE MIDLAND MOTOR CYLINDER CO. LTD., SMETHWICK, STAFFS


CRANKSHAFTS
stamped from Panteg alloy steel
at Austin Motor Company Ltd
Birmingham
RICHARD THOMAS & BALDWINS LTD
PANTEG WORKS, PONTYPOOL, MON.
Head Office:
47 Park Street, London, W.1
RTB

WEDGLOK





Wedglok nuts are completely self-locking. They will not work loose through vibration or reversal of stress. They need no locking devices—and the locking-action is unaffected by age or temperatures within the normal range.

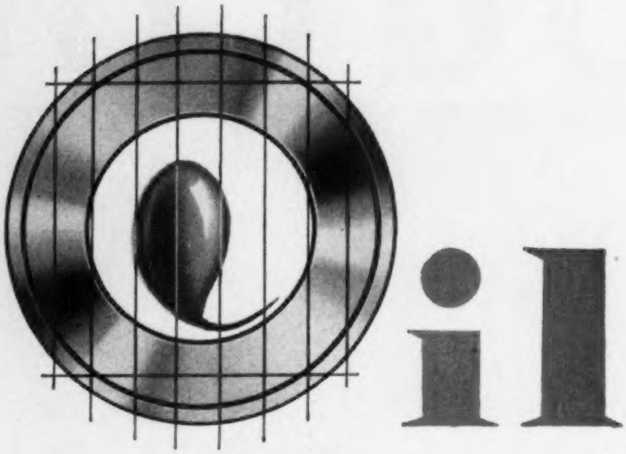
How is it done?

In a Wedglok nut the locking element consists of a tough, resilient nylon pellet. This is inserted in the body of the nut and projects slightly above the crest of the thread. When the nut is turned the pellet sets up a wedging action, gripping the threads tightly. This counter-thrust creates metal to metal engagement of mating threads. The Wedglok principle can be applied to screws as well.

If it's a matter of how to fasten one thing to another . . . get in touch with GKN

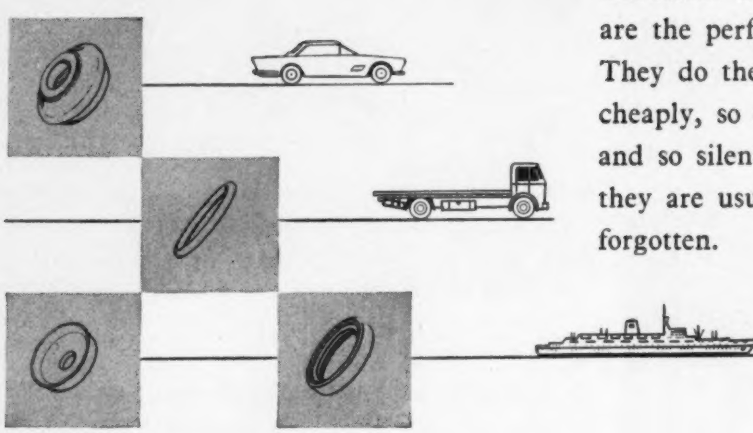
Wedglok Self-Locking Products are manufactured under licence in the United Kingdom solely by
Guest Keen & Nettlefolds (Midlands) Ltd., Screw Division, Box 24, Heath St., Birmingham 18. Tel: Smethwick 1441

s/wx/3825



is a difficult prisoner...

and it must be kept in solitary confinement too; no fraternisation with that insidious enemy dirt, either. SuPerfect Oil Seals are the perfect goalers. They do their job so cheaply, so efficiently, and so silently that they are usually completely forgotten.



SUPER OIL SEALS & GASKETS LTD.
FACTORY CENTRE, BIRMINGHAM, 30.

Manufacturers of 'SuPerfect' Hydraulic Packings and 'O' Rings; 'Romet' water pump seals and mechanical pump seals; 'Aeroquip' Flexible Hose with detachable re-usable fittings; 'Fidrac' mechanical rubber mouldings; 'Redcaps' Polythene Protective Caps and Plugs.

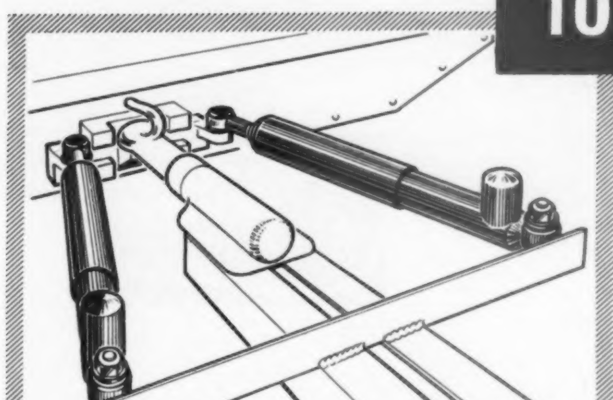
ENV **FOR GEARS**

E.N.V. ENGINEERING CO. LTD., HYTHE ROAD, WILLESDEN, LONDON, N.W.10. Tel.: LADbroke 3622

AP91

WITH THE

GIRLING
PATENTED
TOWING STABILISER

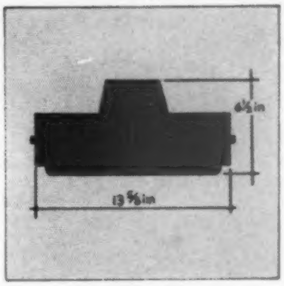


Towing a heavy trailer, a caravan, or a horse-box, can be an uncomfortable, and often dangerous business. It needn't be with this new easily fitted hydraulic damping device from Girling.

The twin hydraulic dampers resist any tendency of the trailer to get out of line with the towing vehicle, thus giving less tiring, safer journeys, and increased confidence on every type of road.

All things considered, it's well worth having this device fitted to any trailer. For the sake of efficiency you'll want to, for the sake of safety you ought to.

GIRLING LIMITED · KINGS ROAD · TYSELEY · BIRMINGHAM 11



one of many decorative designs

The brilliantly successful G.E.C. 101 range of fluorescent fittings offers a wide choice of designs for every lighting requirement — in executive offices, showrooms, shops and stores, as well as factory areas. They are made for 1½ to 8 ft. single or twin Osram guaranteed tubes, and all employ the famous G.E.C. Basic Channel with its proven advantages of versatility and economy in installation and maintenance.

The fitting illustrated, F41138/9, consists of a standard channel with special wide spacing lampholder assembly, together with a metal frame with applied mahogany finish supporting a 040 "Perspex" diffuser.

101 range

fluorescent lighting fittings

G.E.C.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

FLOW CONTROL

SCHRADER FLOW CONTROL VALVES provide a control of movement speed so essential to the effective use of compressed air equipment. The range of valves has now been extended to give even greater flexibility.

The valve is easily set, by means of an adjustment screw, thus determining how fast the air flows in the "adjusted" direction. If used in conjunction with an air cylinder, for instance, the valve can control the pressure build-up and with it the *speed* of the piston thrust, but not its pushing force. This controlled thrust speed avoids the impact shock of suddenly applied air pressure, yet permits full thrust force. When the valve is operating in the "full flow" direction a poppet is opened, giving open line pressure. Where controlled air flow is required in both directions, two valves can be fitted back-to-back.

Although designed primarily for air control, these valves are equally suitable for use with oil or water in hydraulic systems.

Body of cast brass.
Non-corrodible plunger assembly, replaceable in one unit.
Substantial lock-nut resists vibration.

The ⅜" bore valve is the latest addition to the Schrader range, which now covers ⅛", ¼" and ⅜" B.S.P. sizes. These provide a pressure range as follows :—AIR : 0-400 P.S.I. OIL or WATER : 0-800 P.S.I.

- LARGE POPPET TYPE PLUNGER PERMITS FAST, FULL RETURN FLOW.
- LARGE DIAMETER STAINLESS STEEL SEAT GIVES ACCURATE CONTROLLED FLOW. NO NEEDLE POINTS TO CLOG.

Schrader
FLOW CONTROL VALVES

POST THIS COUPON TODAY

To: **A. SCHRADER'S SON**, Air Control Products Dept. AE, **829 TYBURN ROAD, ERDINGTON, BIRMINGHAM, 24**

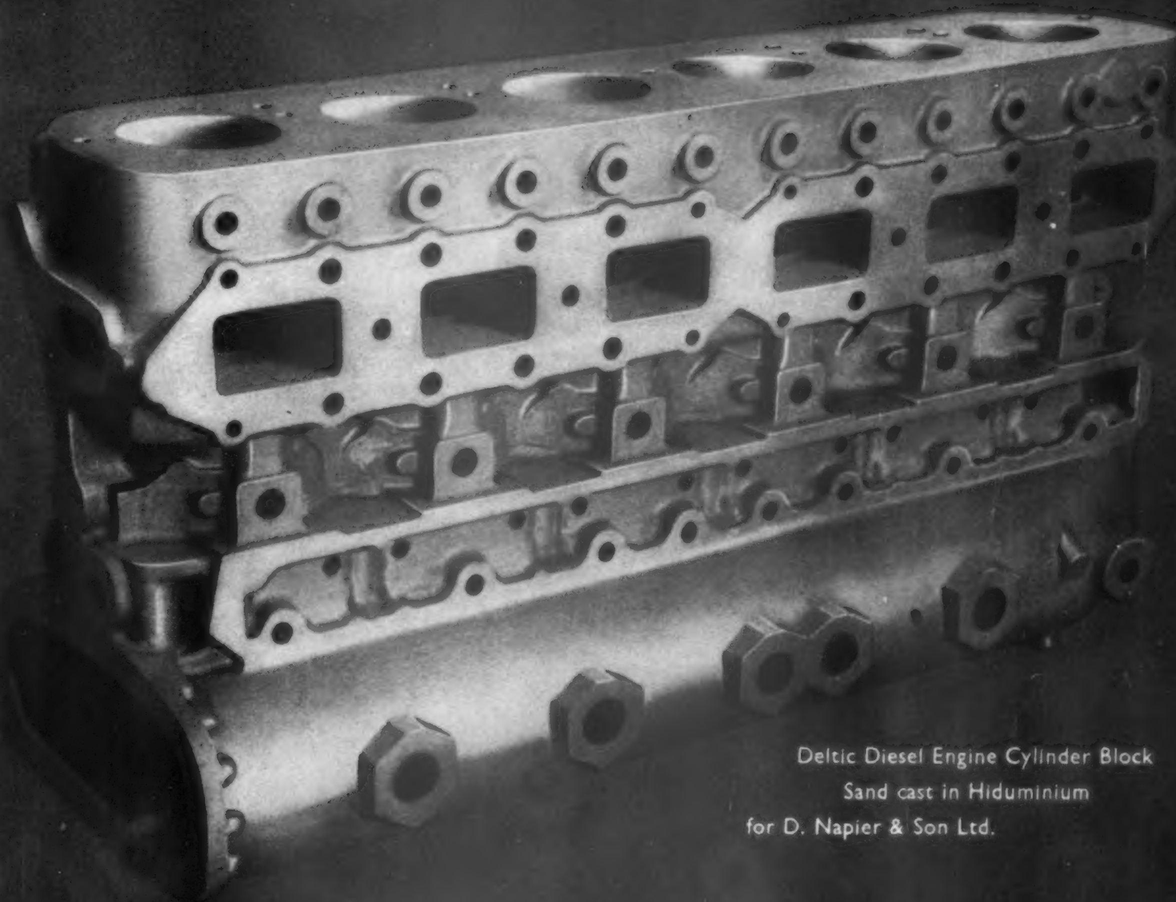
Please send details of Schrader Flow Control Valves

NAME ....

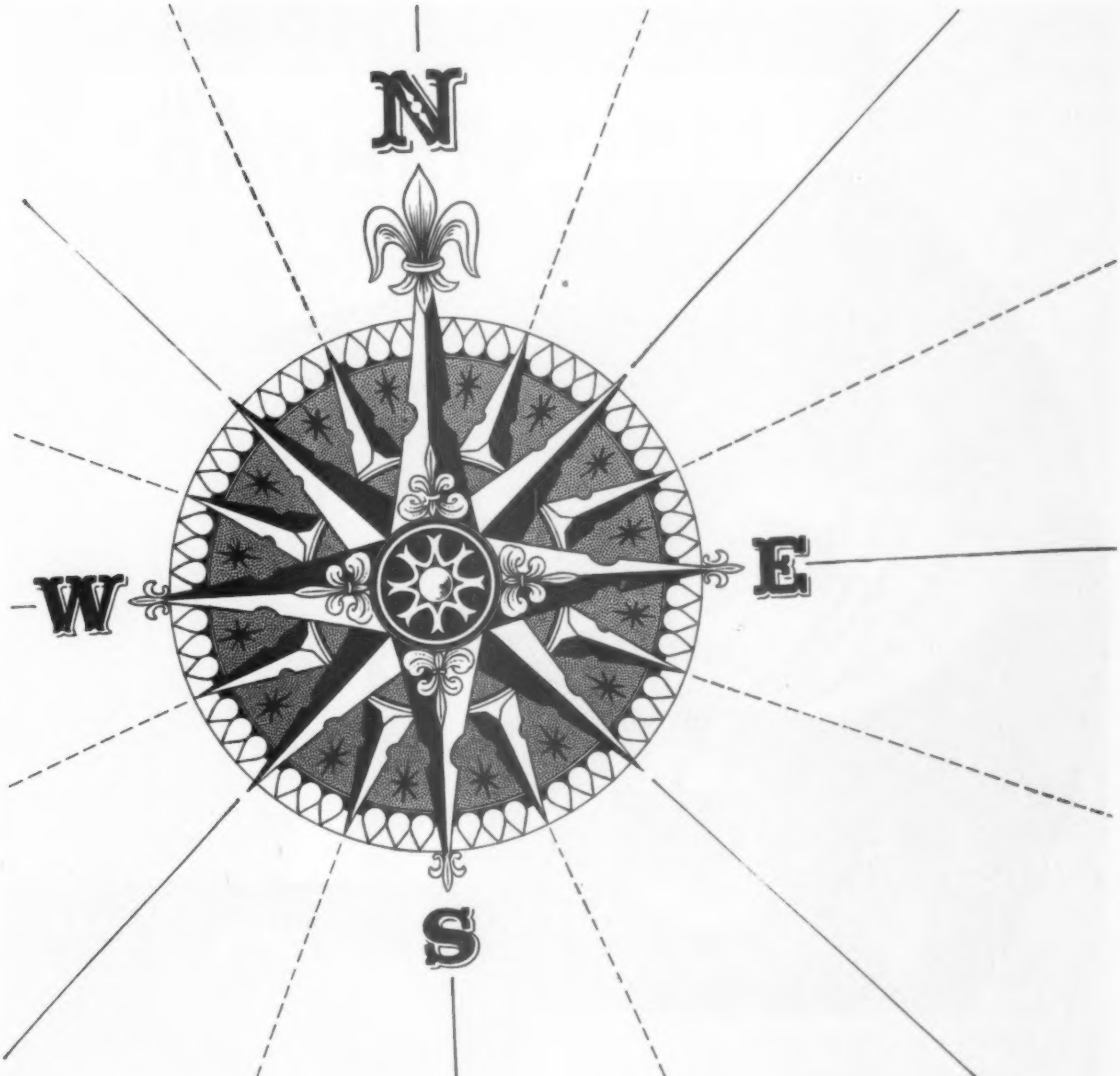
ADDRESS ....

....

12

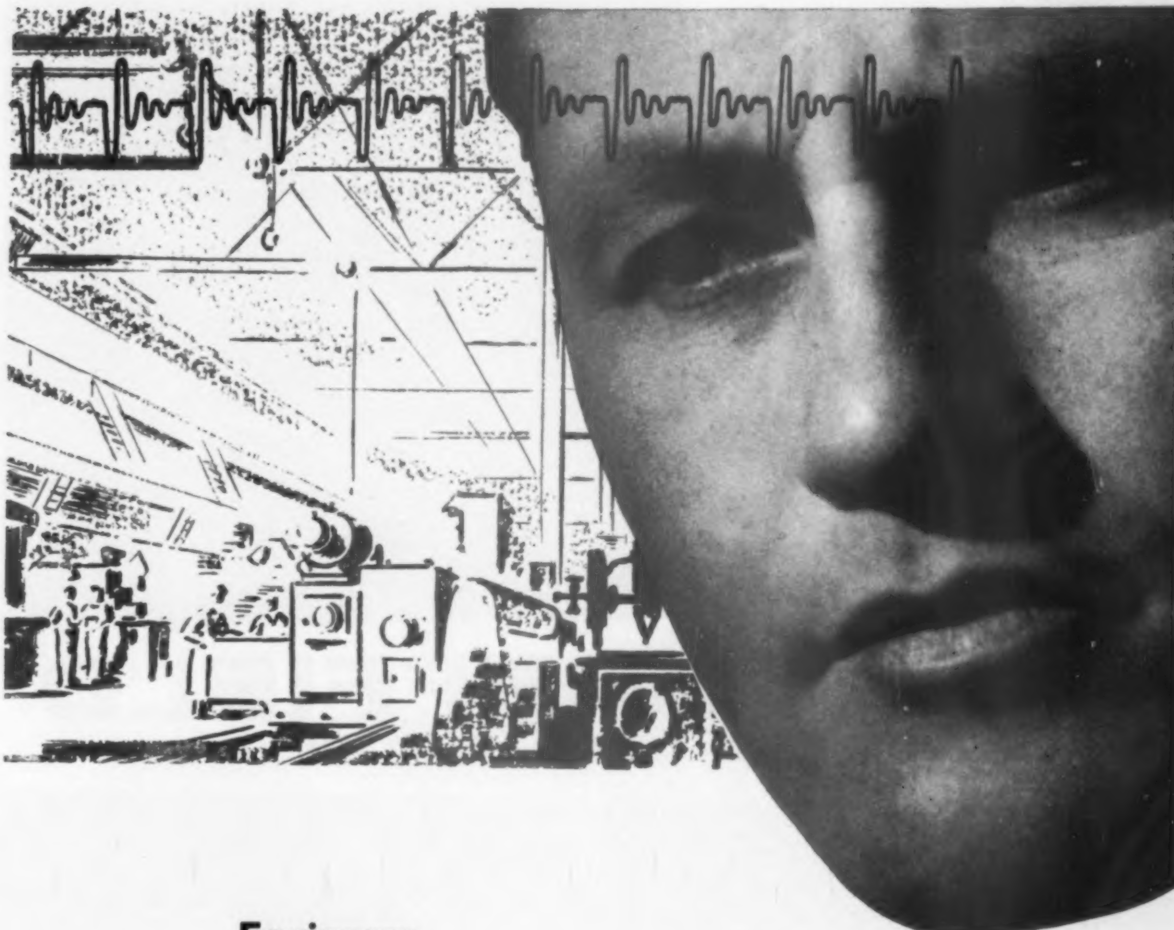


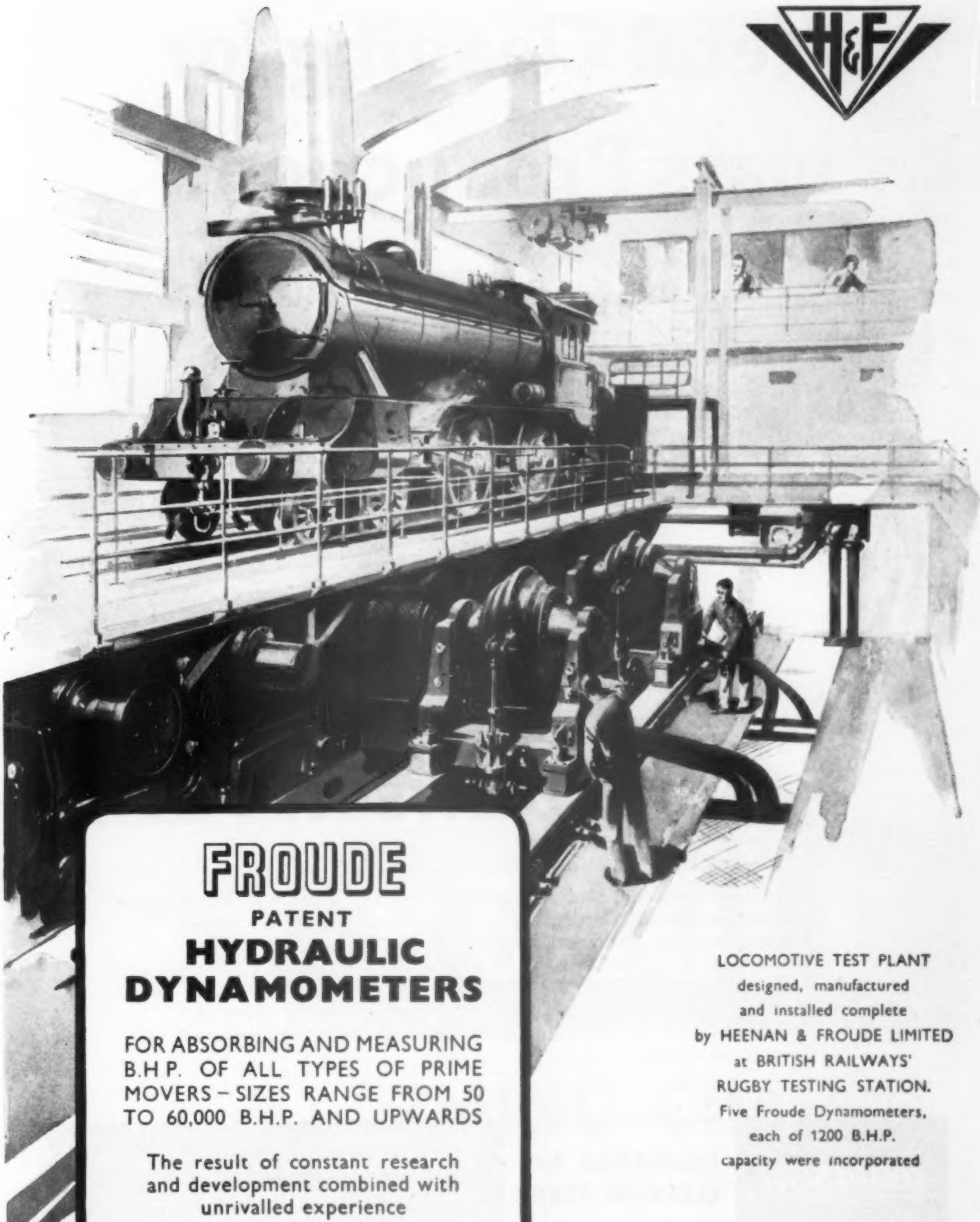
Deltic Diesel Engine Cylinder Block
Sand cast in Hiduminium
for D. Napier & Son Ltd.

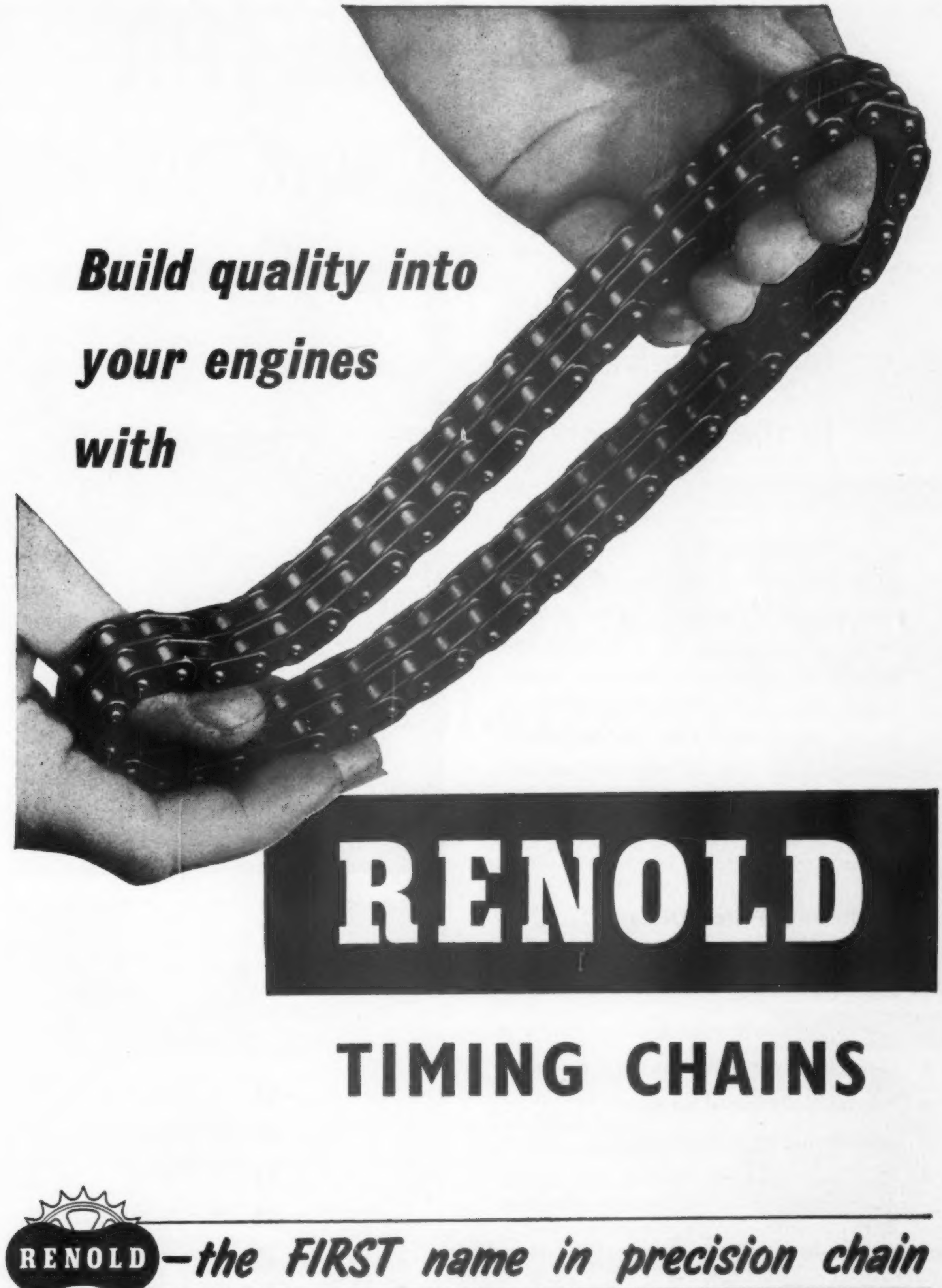

N
E
S
W


vehicle springs
to
your
specification
KANTLINK
SPRING WASHERS
Will not link together into chains; in all sizes A.S.A. Medium and B.S.I. square section.
TOLEDO WOODHEAD SPRINGS LIMITED · SHEFFIELD 3

a new star in the Oilite Galaxy
10, 15 & 20 Tons
AND NOW–
25 TONS
TENSILE
STRENGTH
IN IRON & IRON ALLOYS
A newcomer of first magnitude is announced as an important addition to the Oilite range of sintered metal components. The new alloy iron bearings have a tensile strength approaching that of mild steel and have the equivalent self-lubricating properties of other Oilite alloys. These new components are particularly reasonable in cost because they are made in line with standard Oilite production. Cyanide hardening may be carried out with sections of suitable thickness.
Please send for full details of this and other Oilite materials
Oilite
self-lubricating bearings and powder metal parts
OILITE NEW RANGE 20 & 25 TONS
Superload sintered copper iron 15 TONS
standard sintered iron 10 TONS
THE MANGANESE BRONZE & BRASS COMPANY LIMITED
ELTON PARK WORKS · HADLEIGH ROAD · IPSWICH · TELEGRAMS OILITE IPSWICH · TELEPHONE IPSWICH



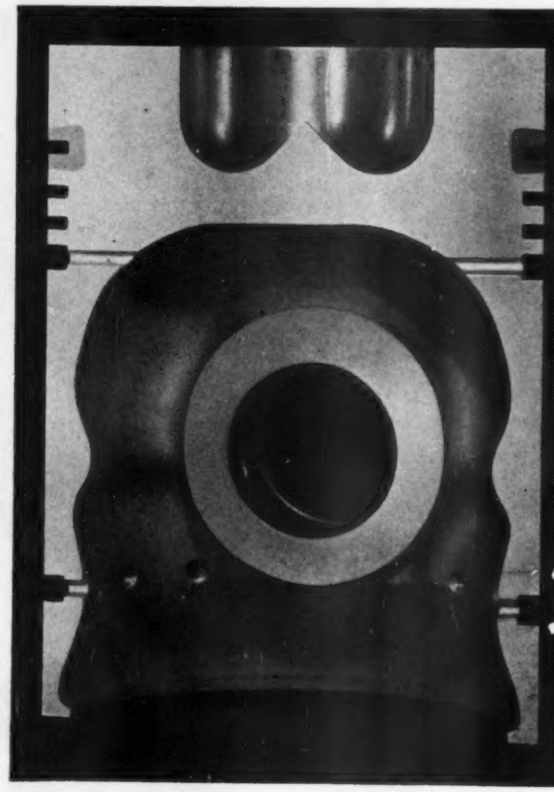



Build quality into
your engines
with
RENOLD
TIMING CHAINS
RENOLD
—the FIRST name in precision chain
RENOLD CHAINS LIMITED MANCHESTER

Wellworthy AL-FIN armoured ring groove pistons

. . . more than pay for themselves in the first year!

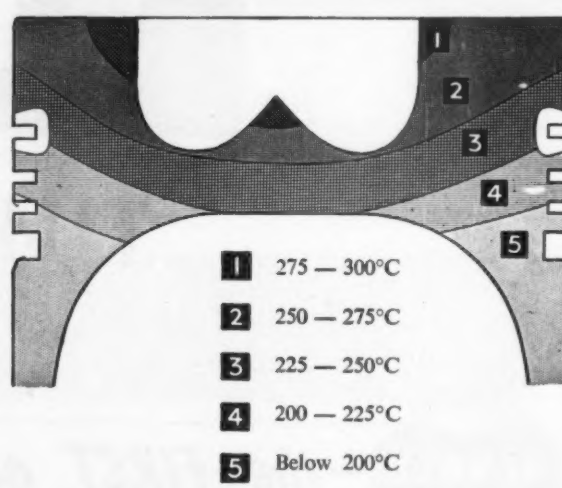
The top ring groove of the Al-Fin Piston has an austenitic cast iron insert bonded to the alloy giving strength where it is most required. This iron bonded securely to the alloy during the casting of the piston will stand up to the most severe usage. That means piston life is increased by at least 100%. This double mileage saves you the cost of one overhaul *and* the cost of another set of pistons! *Write for leaflet A*20/3



Isothermal Piston Design.....

Wellworthy use Isothermal Survey in diesel engine piston design to ensure:

- Correct selection of materials.
- Determination of correct running clearances.
- Avoidance of localised hot areas.
- Correct gudgeon pin alignment.
- That head thickness, coupled with correct blending into piston wall overcomes distortion of ring grooves. This has considerable bearing on blow-by and efficient oil control.

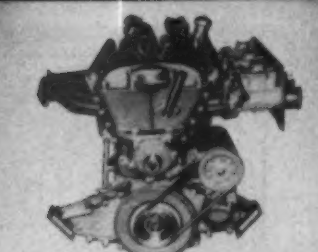


WELLWORTHY LIMITED · LYMINGTON · HANTS

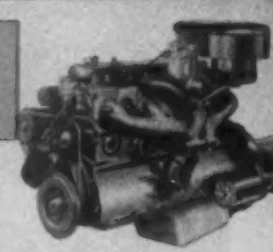
DAMPING

TORSIONAL

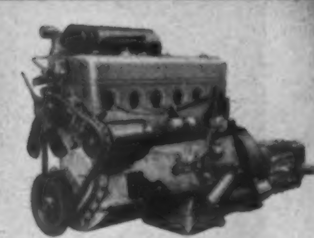
VIBRATION



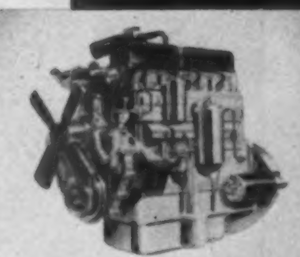
David Brown
Aston Martin 3-litre engine



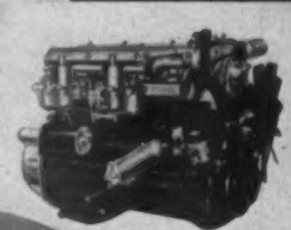
B.M.C. 'C' series engine



Daimler D.K. 400 engine



Humber Hawk 2267 c.c. engine



Jaguar 3·4-litre engine

Leaders in design

The two greatest advances in smoothing the present-day high-performance engine are the rubber torsional vibration damper and 'floating power' engine mountings. Both were developed by Metalastik.

Metalastik torsional vibration dampers, with their instant response to vibrations of even the slightest amplitude, need no description; their effectiveness is widely known.

Extensive experience with so many different types of engine, coupled with modern test equipment, makes it possible for us to predict accurately the performance of Metalastik torsional vibration dampers. Moreover, by our design methods a damper can be designed so as to transfer critical frequencies to other and less critical ranges.

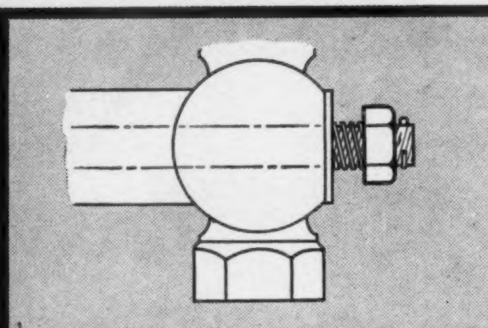
Lastly, Metalastik T.V. Dampers permit a great range of r.p.m. without detriment to the engine.

It is this unique combination of advantages that has made the Metalastik torsional vibration damper such a widespread success.

The small illustrations show some famous petrol engines with Metalastik T.V. Dampers. Equally successful on diesel engines, many world-known oil-engine manufacturers fit Metalastik dampers.

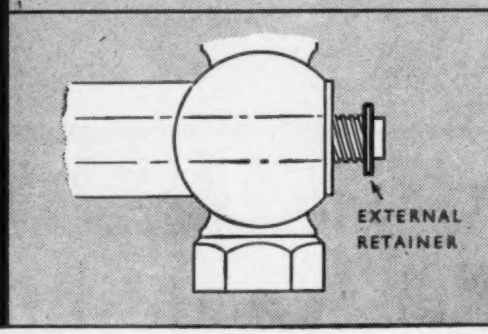
METALASTIK

The logical advance in Retaining



OLD WAY

To provide a shoulder for the tensioning spring on this filler cup entailed an extra long, threaded shaft, a nut, a hole drilled to take a cotter pin and an altogether tedious assembly.



THE SALTER WAY

The spring is quickly positioned on a shorter, **PLAIN SHAFT** by a ***Grip Ring*** which is snapped into position for secure, frictional grip. No groove required.

save material–reduce assembly time–cut costs

When it's a question of assembling components in any engineering field, Salter Retainers are the answer. They replace nuts and bolts, screws, cotter pins, and eliminate expensive threading and machining operations. A large standard range is at your immediate disposal, and we should welcome the opportunity to assist in developing special retainers to solve your problems.

NEATER – MORE POSITIVE – PERMANENT RETAINING

Send for the Salter Retainer catalogue — no designer is complete without it.

SALTER

"TRUARC" Regd. Trade Mark

Circlips *Fasteners* *Retainers* *Fixes*

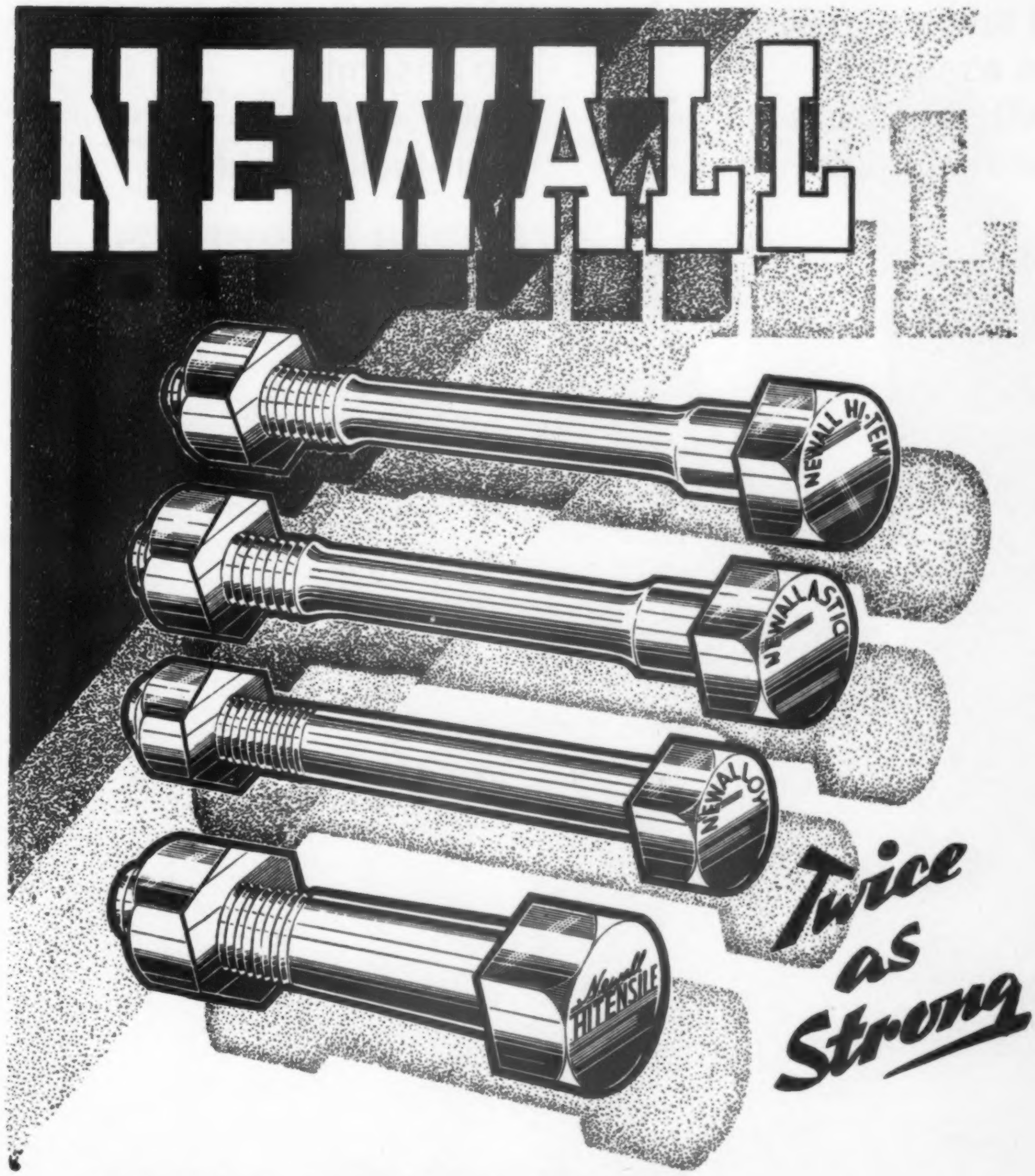
Geo. Salter & Co. Ltd., West Bromwich. *Spring Specialists since 1760*

M-W.444


NEW
MILLING
TOOLS!
HIGH-SPEED STEEL
SCREW SHANK
END MILLS
(WITH EXCLUSIVE TOOTH FORM)
HIGH-SPEED STEEL
SCREW SHANK
SLOT DRILLS
(WITH EXCLUSIVE TOOTH FORM)
THE
'TITANIC'
CHUCK
(INCORPORATING MANY
NEW DESIGN FEATURES)
OSBORN
The superior design of these products is the result of prolonged research and development. They are far in advance of similar tools of comparable price and much faster speeds and feeds are achieved with the cutters. Please write for leaflet No. 11 "AN ADVANCE IN MILLING".
★ Comprehensive stocks constantly maintained
SAMUEL OSBORN & CO., LIMITED
CLYDE STEEL WORKS · SHEFFIELD
Fine Steelmakers · Steelfounders · Engineers' Toolmakers


HEAVY castings
Well, heavier than we have previously supplied. We have increased our capacity in the floor moulding department and can now supply castings up to 5 tons weight in grey iron, and up to 2 tons weight in aluminium alloy.
Intricate castings
These have been our speciality for many years. Let us examine your casting problems.
We supply grey iron castings made in green sand, dry sand, and by the shell moulding process.
Our aluminium foundries use the green sand, gravity die, pressure die and plaster processes.
CAST WELL & TRUE for quantity supply
West Yorkshire Foundries Ltd.
SAYNER LANE, LEEDS 10
Telephone LEEDS 29466
London Office:
HANOVER HOUSE, HANOVER SQ., W.1
Telephone MAYfair 8561

NT706


NEWALL
NEWALL HI-TEM
NEWALLASTIC
NEWALLOY
Newall HITENSILE
Twice as Strong

It takes him 60 minutes*
to assemble
100 $\frac{1}{4}$" full nuts
and jam nuts

It takes him 40 minutes*
to assemble
100 $\frac{1}{4}$" Nyloc
self-locking nuts!

By using one $\frac{1}{4}$" Nyloc self-locking nut instead of a full nut and a jam nut you could save 20 minutes and approximately 2/- on every hundred assemblies. On some jobs, Simmonds self-locking nuts could save many a company *up to £2,000 a year!* Why not call in Simmonds to carry out a completely thorough costing of your present assembly methods? Our 16mm Nyloc colour film is available for showing in your factory.

** All times based on the Haddon & Genger Standard Data (1955) Handbook. Costs include wages at 5/- an hour and overheads at 250%.*

time saved is money saved **SIMMONDS SELF-LOCKING NUTS**

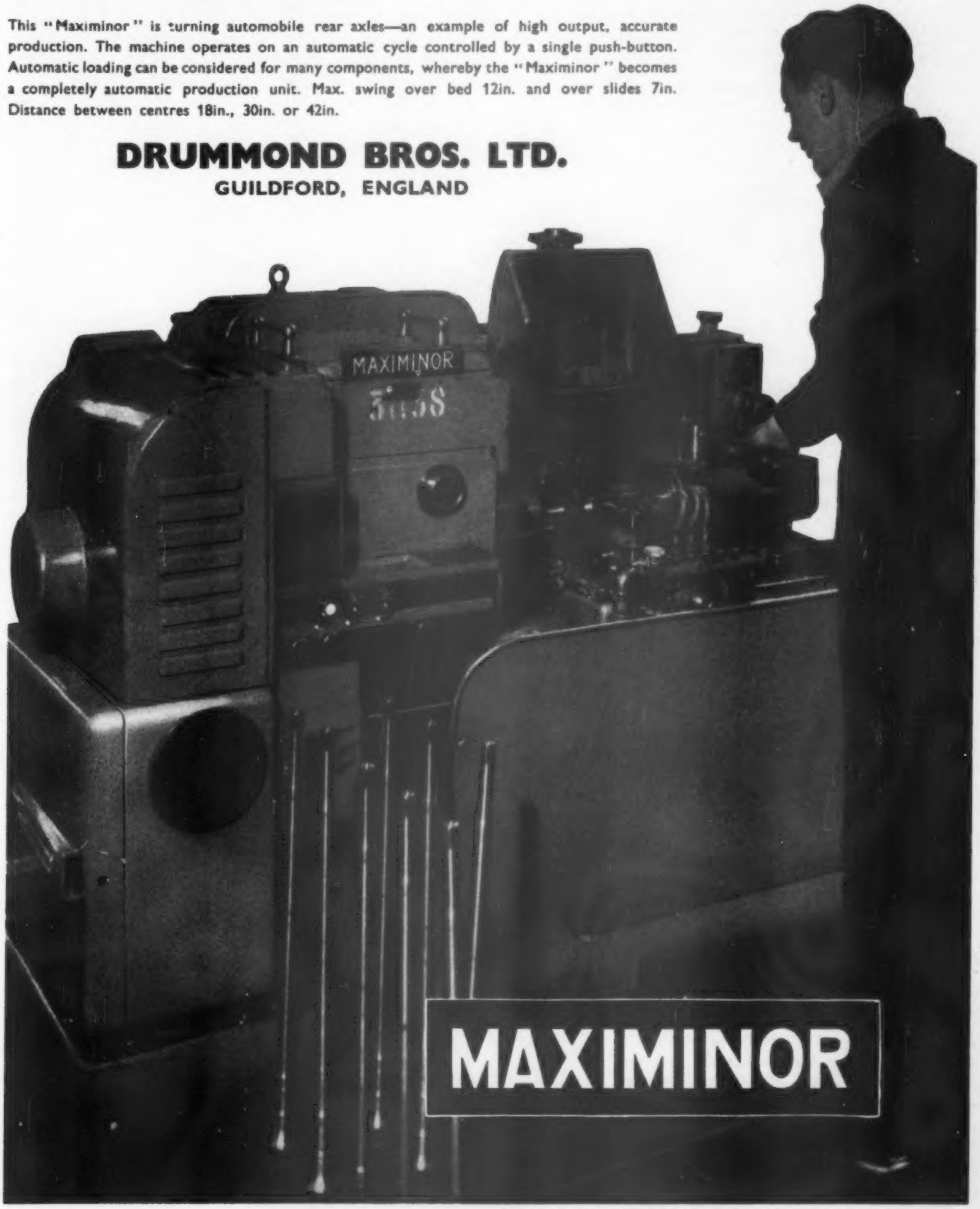
SIMMONDS AEROCESSORIES LTD · TREFOREST · PONTYPRIDD · GLAMORGAN

FC *A member of the Firth Cleveland Group*
CRC 41N

Fast, automatic multi-tool turning

This "Maximinor" is turning automobile rear axles—an example of high output, accurate production. The machine operates on an automatic cycle controlled by a single push-button. Automatic loading can be considered for many components, whereby the "Maximinor" becomes a completely automatic production unit. Max. swing over bed 12in. and over slides 7in. Distance between centres 18in., 30in. or 42in.

DRUMMOND BROS. LTD.
GUILDFORD, ENGLAND



Sales & Service for ... **DRUMMOND-ASQUITH** *... the British Isles*

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM
'Phone: Midland 3431 (7 lines) Grams: Maxishape, Birmingham. Also at LONDON: 'Phone: Trafalgar 7224 (5 lines) and GLASGOW: 'Phone Central 0922

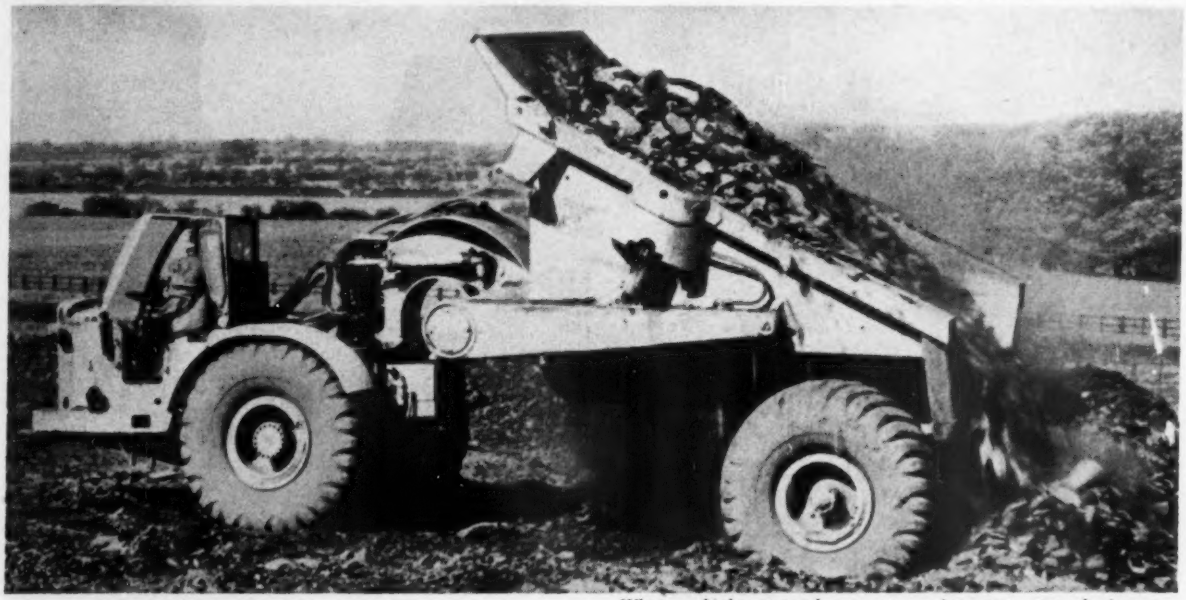
D273

COR-TEN IS STILL NEWS

In 1954, for the first time in Britain on a wide continuous strip mill, The Steel Company of Wales began the manufacture of SCW Cor-Ten.

Today, four years later, the range of application for SCW Cor-Ten continues to grow as more designers and more users discover new ways in which they can take advantage of its outstanding properties.

Photograph by courtesy of Caterpillar Tractor Company Ltd.



Wherever higher strength or greater resistance to atmospheric corrosion offer economic advantages, SCW Cor-Ten *has been used. Where corrosion and abrasion are both present (as in the case above)* SCW Cor-Ten's *outstanding advantages are particularly effective.*

COR-TEN IS TOUGHER

- Weight for weight, the yield strength of SCW Cor-Ten is 50% higher than ordinary mild steel
  alternatively
  Strength for strength, a saving of ⅓ of the weight is possible
- 4-6 times more resistant to atmospheric corrosion
- Highly resistant to abrasion and fatigue.

COR-TEN SAVES MONEY

- Initial costs are spread over a longer service life
- Maintenance costs are reduced
- Operating costs are lowered—in transport applications payloads are bigger because of reduction in tare weight

Please write to us at the address below for further information or for technical assistance in the application of **SCW Cor-Ten** ***to your products***

S·C·W BRAND

Cor-Ten

RAILWAY ROLLING STOCK
AGRICULTURAL AND EARTH-MOVING EQUIPMENT
MINE CARS · POWER STATION INSTALLATIONS
BARGES AND SMALL CRAFT

THE STEEL COMPANY OF WALES LIMITED

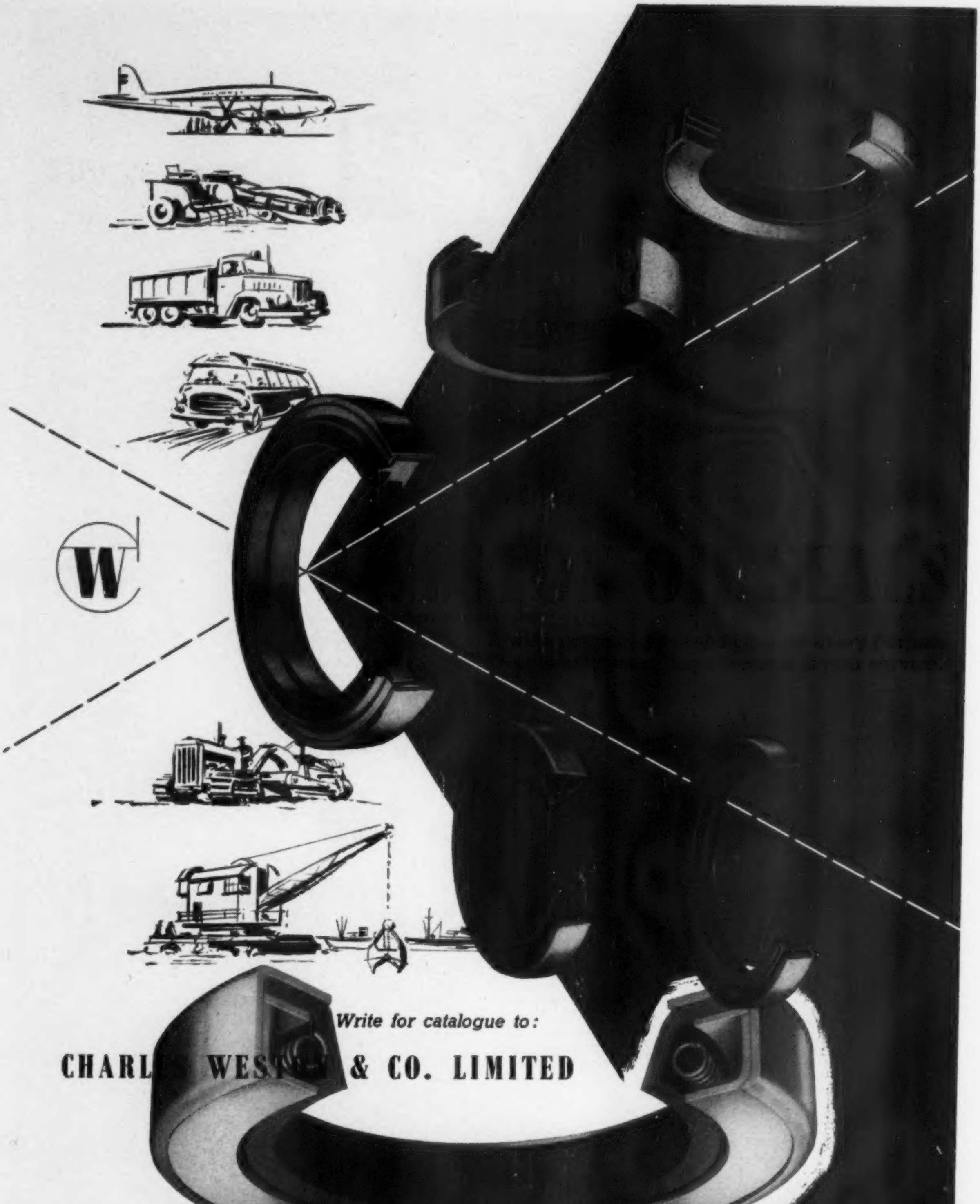
ABBEY WORKS, PORT TALBOT, GLAMORGAN TELEPHONE: PORT TALBOT 3161


HOFFMANN
BALL AND ROLLER
BEARINGS
FOR EVERY TYPE OF AUTOMOBILE APPLICATION
UNIVERSAL JOINTS TO GEAR BOXES
THE HOFFMANN MANUFACTURING CO. LTD., CHELMSFORD, ESSEX

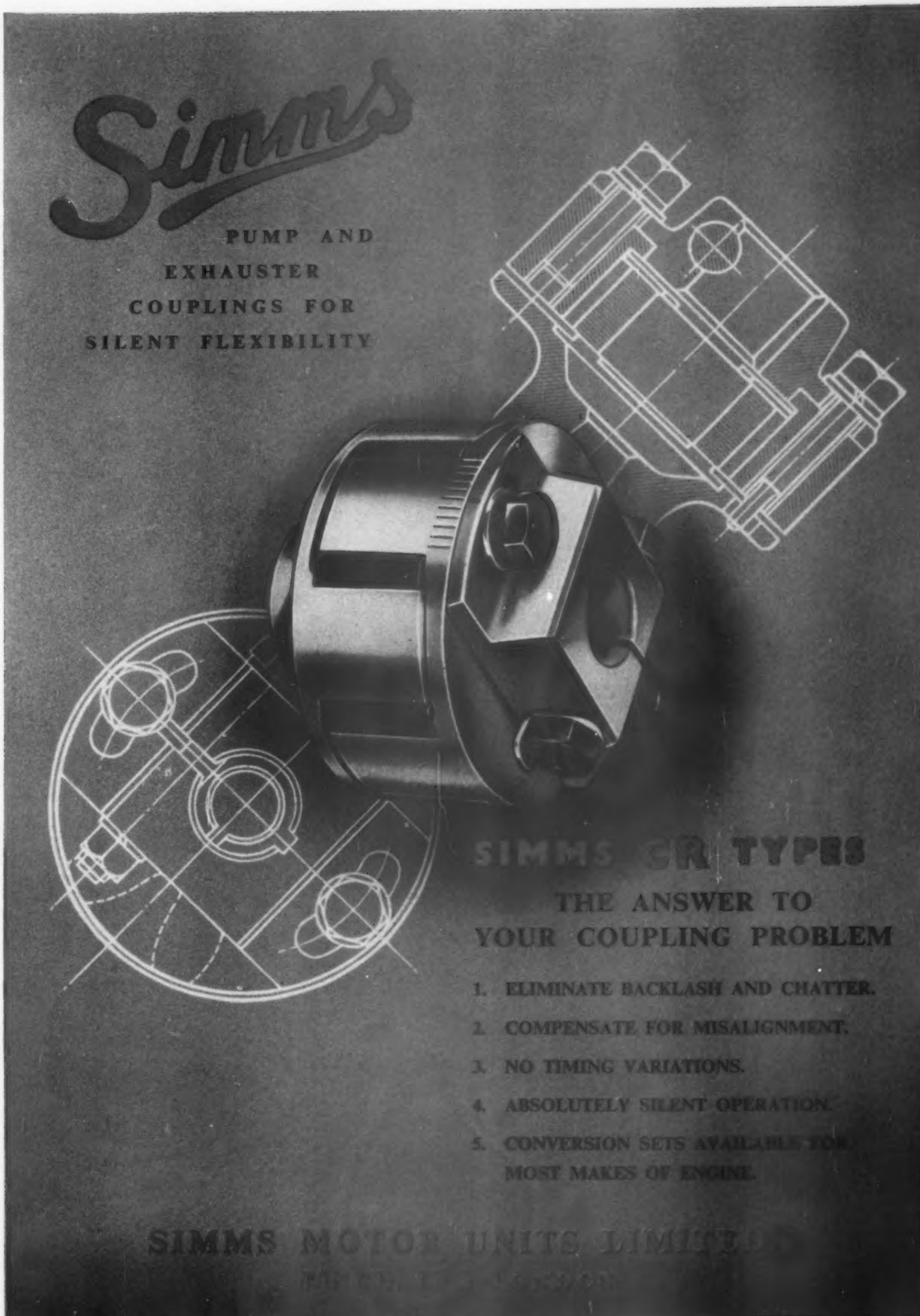

CAPASCO

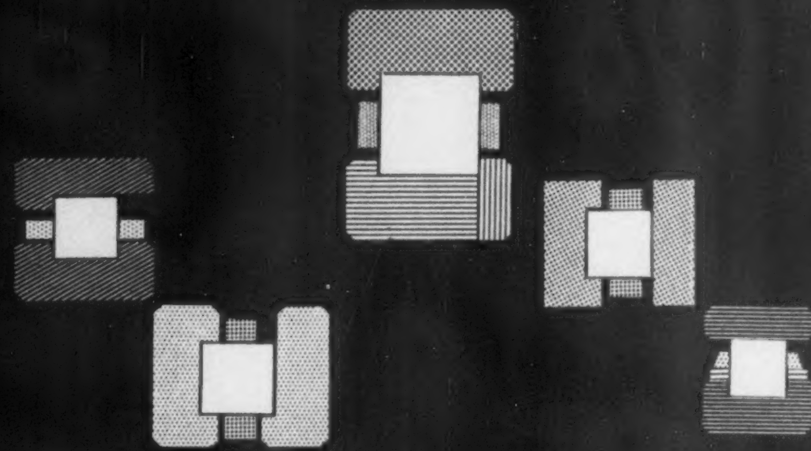
A REMINDER. We shall be pleased to see you at Enots Film Show and Exhibition of Pneumatic and Lubrication Equipment on April 13, 14 and 15th, 10 a.m. to 8 p.m., PARK LANE HOUSE, 45 Park Lane, London W.1. (near Dorchester Hotel).


USE
Eclipse
HACKSAW BLADES
ECLIPSE
HIGH ... ED STEEL
USE A ... PSE FRAME
and
feel
the
difference !

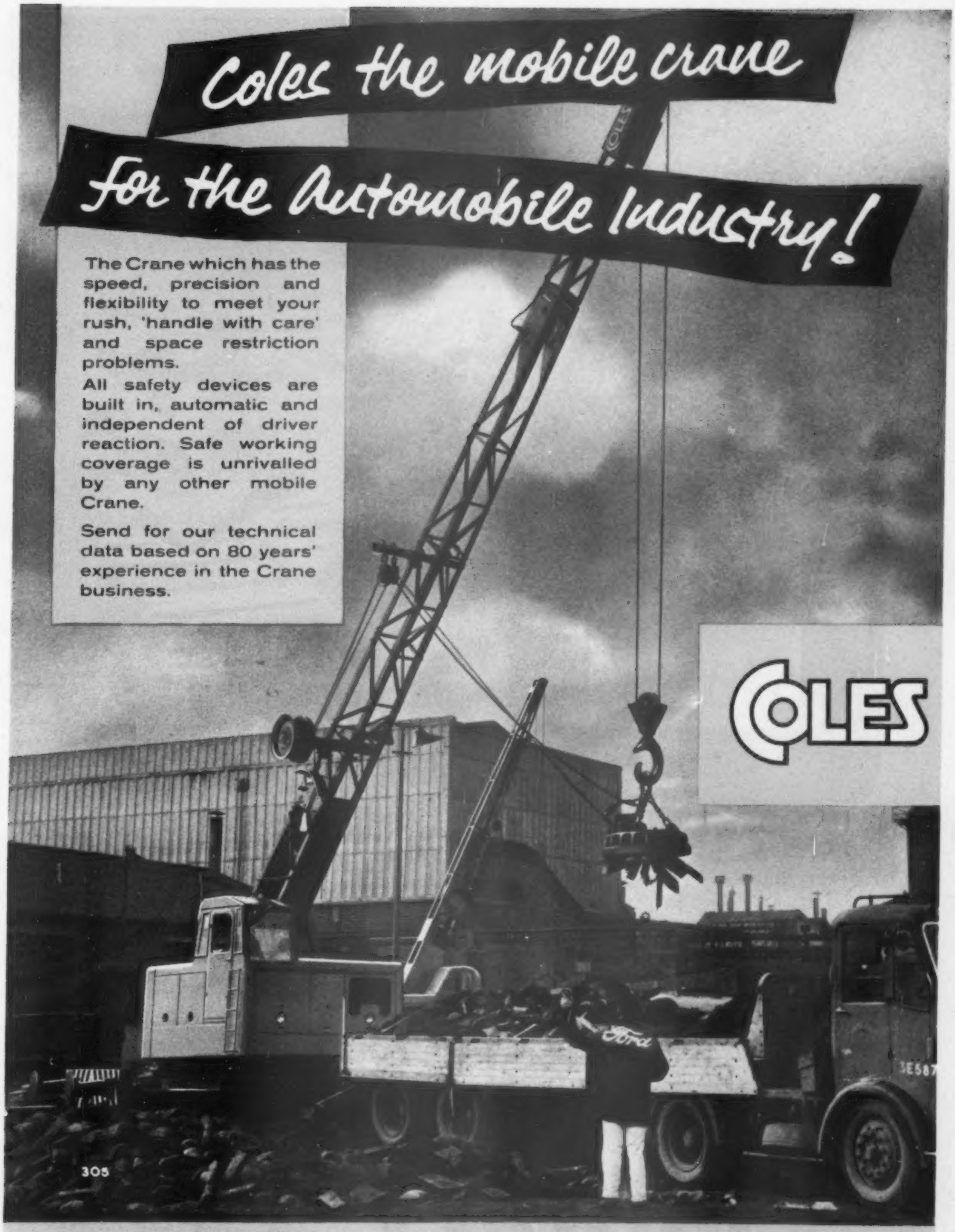


Write for catalogue to:
CHARL WEST & CO. LIMITED
IRWELL BANK WORKS · DOUGLAS GREEN · PENDLETON
TELEPHONE: PENDLETON 2857-8-9 BIRMINGHAM: ERDINGTON 5459 LONDO
TELEX 66-255


Simms
PUMP AND
EXHAUSTER
COUPLINGS FOR
SILENT FLEXIBILITY
SIMMS CR TYPES
THE ANSWER TO
YOUR COUPLING PROBLEM
1. ELIMINATE BACKLASH AND CHATTER.
2. COMPENSATE FOR MISALIGNMENT.
3. NO TIMING VARIATIONS.
4. ABSOLUTELY SILENT OPERATION.
5. CONVERSION SETS AVAILABLE FOR
MOST MAKES OF ENGINE.
SIMMS MOTOR UNITS



Coles the mobile crane for the Automobile Industry!



The Crane which has the speed, precision and flexibility to meet your rush, 'handle with care' and space restriction problems.

All safety devices are built in, automatic and independent of driver reaction. Safe working coverage is unrivalled by any other mobile Crane.

Send for our technical data based on 80 years' experience in the Crane business.

COLES

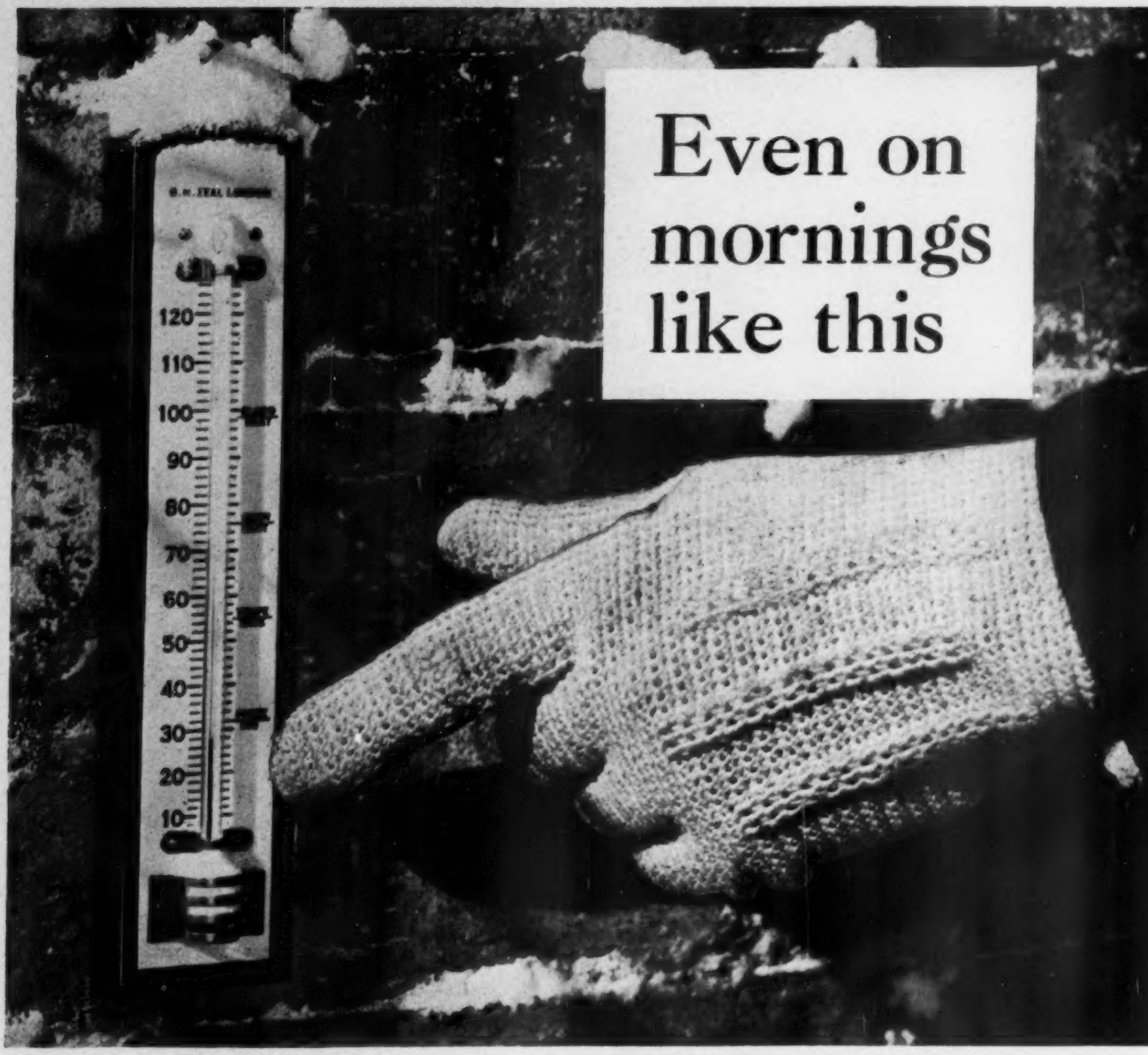
305

Designed, manufactured and marketed by:—

STEELS ENGINEERING PRODUCTS LIMITED, Sunderland, England

SALES AND SERVICE: Birmingham, Glasgow, London, Manchester and Newcastle

COLES THE NAME THAT CARRIES WEIGHT



YOU'LL GET EASY-AS-SUMMER STARTING WITH

BP Energol 'Visco-static'*

MOTOR OIL

Do you know the most frequent reason why engines are difficult to start in cold weather? It's that the cold makes conventional oils become so thick that the engine is hard to turn.

But today you can prevent all that kind of trouble. With BP 'Visco-static' in your sump you can be sure of an easy start. Tests prove this oil flows freely even at 32 degrees of frost (0°F).

What a wonderful difference this makes! You start more easily. You use less choke – and therefore less petrol. Your engine runs more easily, more smoothly, delivers more power. It saves your battery. And it cuts engine wear too because your engine isn't oil starved in the first few minutes after a cold start.

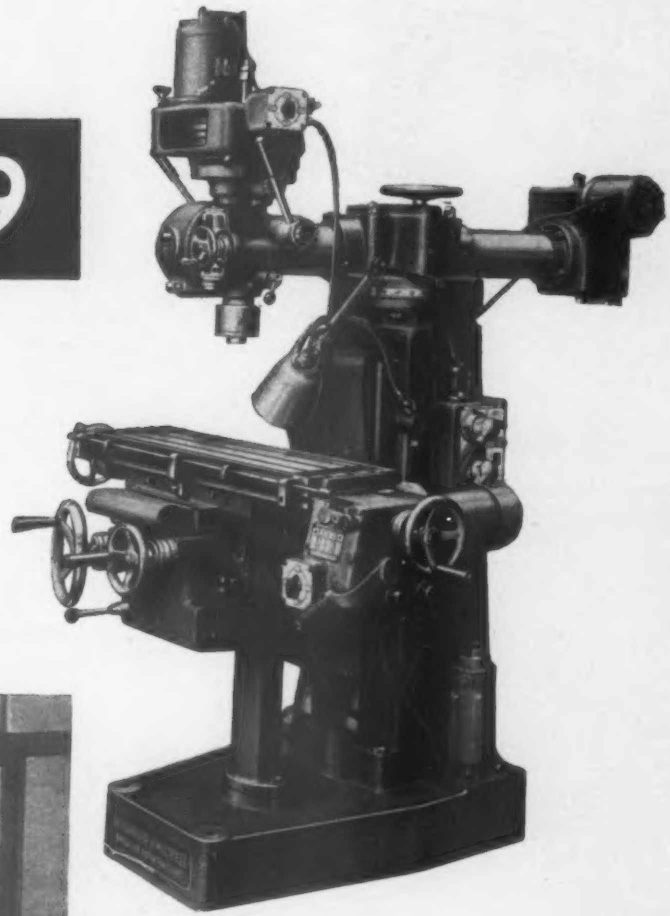
But BP 'Visco-static' is more than just a thin winter oil. It is for all the year round use. It has the remarkable property of giving the right lubrication at all temperatures – from icy cold to full racing heat. Tests with the radio-active wear detector prove 80% less engine wear with BP 'Visco-static' compared with conventional oils.

Change to BP 'Visco-static' this winter – you will save all along the line.

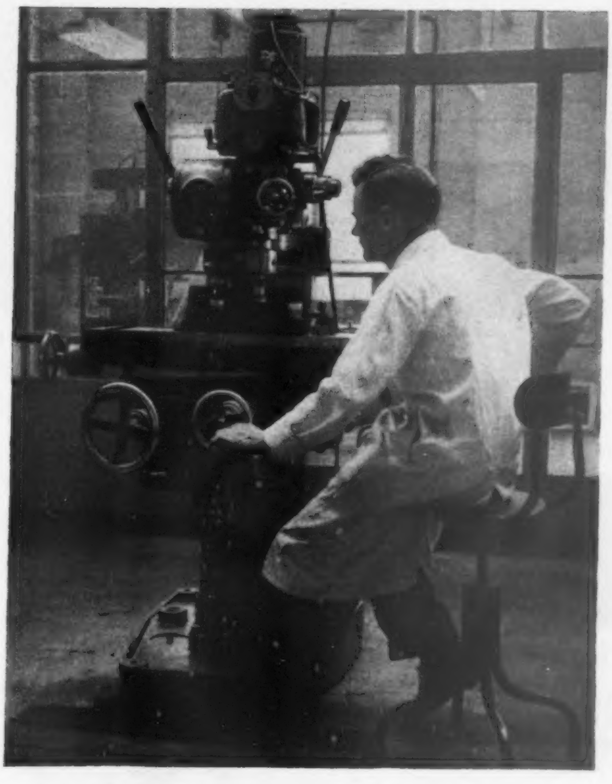
BP Energol 'Visco-static' Motor Oil is officially approved by Rolls-Royce for all their post-war motor cars.

BP * 'VISCO-STATIC' IS A TRADE-MARK OF THE BRITISH PETROLEUM COMPANY LIMITED

WM 369



The Versatile Turret Miller



For milling, boring, and jig boring at any angle, keyway and end milling, die sinking, mould and pattern making. The machine illustrated above is fitted with table power feed and slotting head as extras.

Illustrated left; the WM 369 at work at the P & N Tool Co. Ltd., Uxbridge.

Write for illustrated brochure: 'The WM 369'

WOODHOUSE & MITCHELL

WAKEFIELD ROAD
BRIGHOUSE YORKS
PHONE :— BRIGHOUSE 627 (3 LINES)
GRAMS:— 'WOODHOUSE BRIGHOUSE'

WM.88

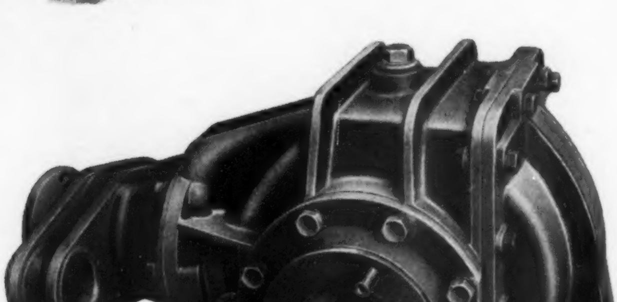
The real quality of any automobile transmission component is invisible.

Careful design, first-class materials, accurate manufacture and inspection all affect the service you will get but efficient, long and trouble-free life depends primarily on the invisible quality, the rigorous and exhaustive testing of the production components under actual operating conditions.

S430

4-speed, close-ratio, synchromesh gearbox for maximum engine torque 150 lb.ft.

linked with outstanding success



8¼

spiral bevel rear-axle unit, matched with the S430 gearbox and offering a choice of ratios

You can buy this invisible quality with every David Brown unit. The S430 gearbox and 8¼ rear-axle unit for instance have been proved together over a long period of high-speed racing, where the stresses of many years of normal service are crowded into 24 hours or less.

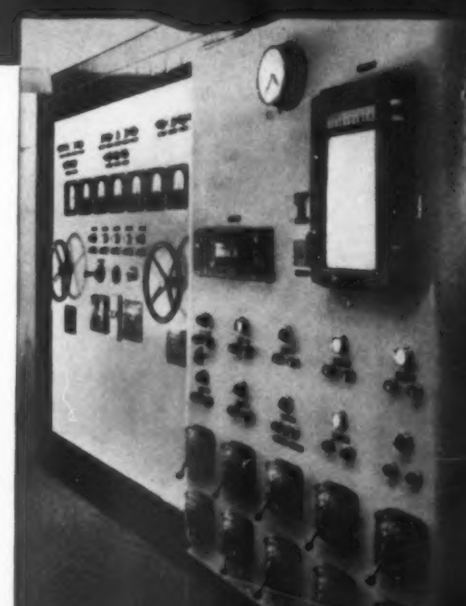
Send for details of these units in the confident knowledge that, in addition to a first-class specification, you will be offered a thoroughbred, race-proved team of matched components.

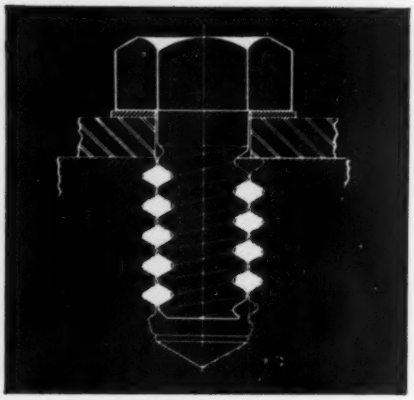
The **DAVID BROWN**

CORPORATION (SALES) LIMITED

AUTOMOBILE GEAR DIVISIONS

PARK WORKS HUDDERSFIELD





almost limitless possibilities of saving in time and cost

HELI-COIL*

screw thread inserts

Heli-Coil Inserts are self-anchoring thread liners made from high tensile stainless steel wire. In tapped holes they provide a conventional thread with higher loading strengths and greater resistance to wear and stresses than unprotected threads. The Heli-Coil eliminates stripping, seizing, galling and corrosion. It literally *armours* the thread. The Heli-Coil offers a unique opportunity for product cost revision. It is "a natural" for automation, it can make dramatic cuts in time and labour costs. Assembly is the ultimate in simplicity—just drill, tap and install. The Heli-Coil saves weight and space. It improves the serviceability and appearance of the end product. We suggest you write soon for data on Heli-Coil, the British-made Insert that is available internationally. It is a product of the day and this atomic age.

For further details write for sales leaflet APL. 48/E2.

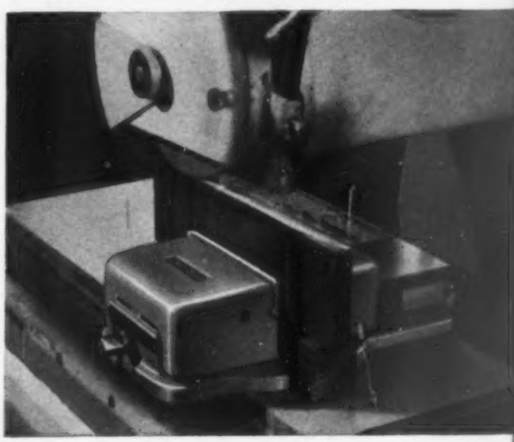
ARMSTRONG PATENTS CO. LTD. EASTGATE, BEVERLEY, YORKSHIRE

BEVERLEY 82212

* *HELI-COIL is a registered trade mark*

. . . . Whether you're Drilling, Reaming . . .

. . . Milling, Slotting

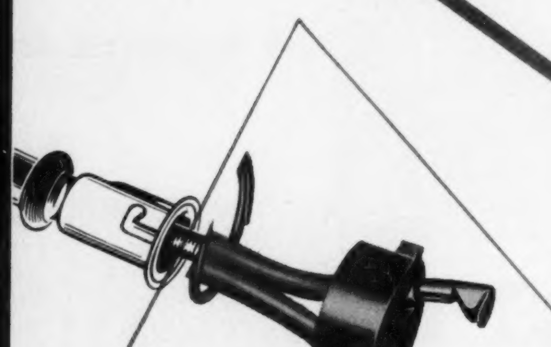


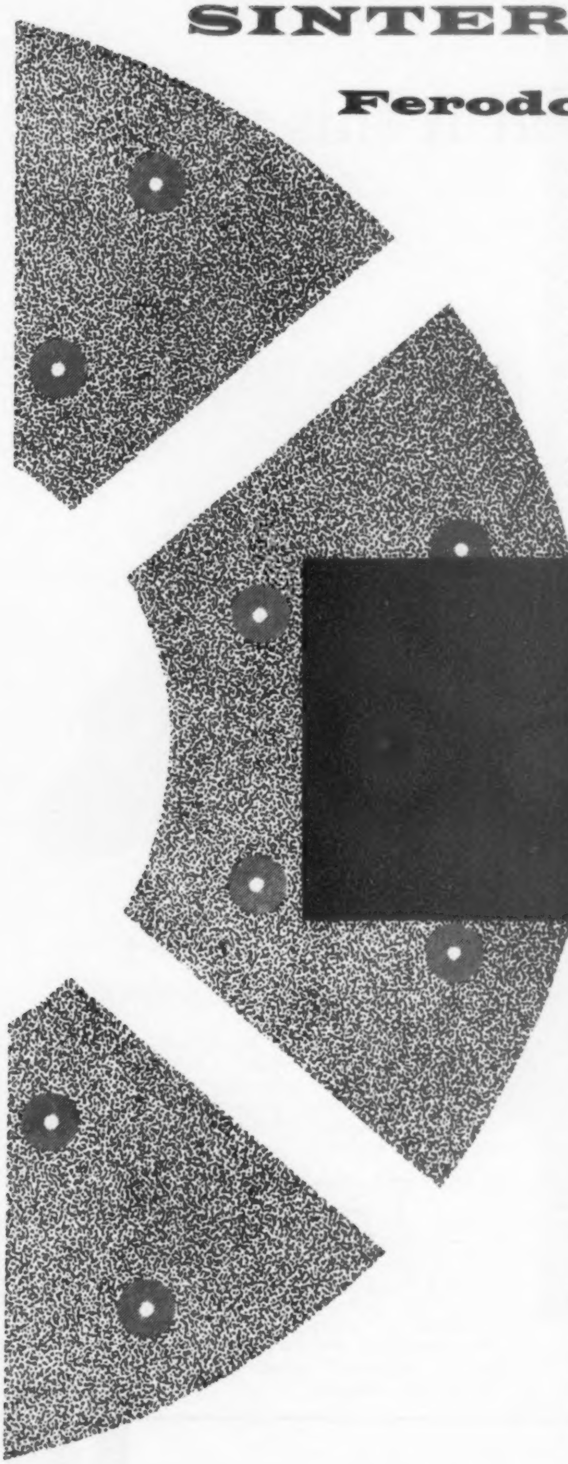
or Surface Grinding . . . . . .

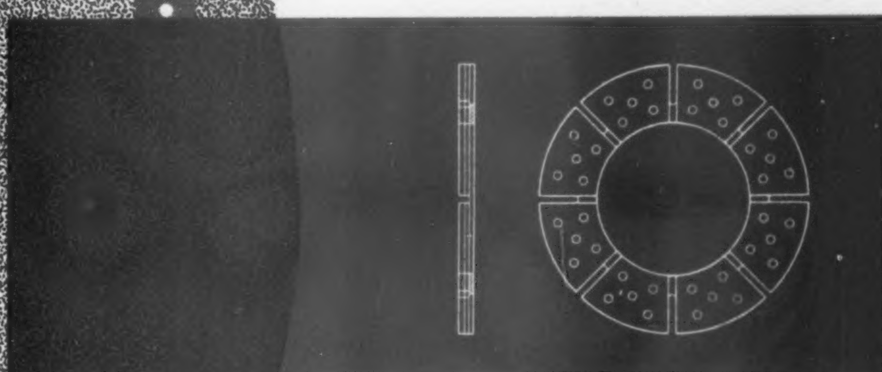
you can secure the work with a **DORMER DOWN GRIP MACHINE VICE** *precisely!*

THE SHEFFIELD TWIST DRILL AND STEEL COMPANY LTD., SHEFFIELD, ENGLAND

DORMER PRECISION MACHINE VICES ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS







Look at it this way . . .

. . . or this way . .

. . . or even this way

. . . the best brake discs
and calipers are in high duty
cast iron by

DARCAST

DARTMOUTH AUTO CASTINGS LTD. SMETHWICK 40 STAFFS

SPECIALISTS IN HIGH DUTY IRON CASTINGS

DARCAST

AUTOMOBILE ENGINEER

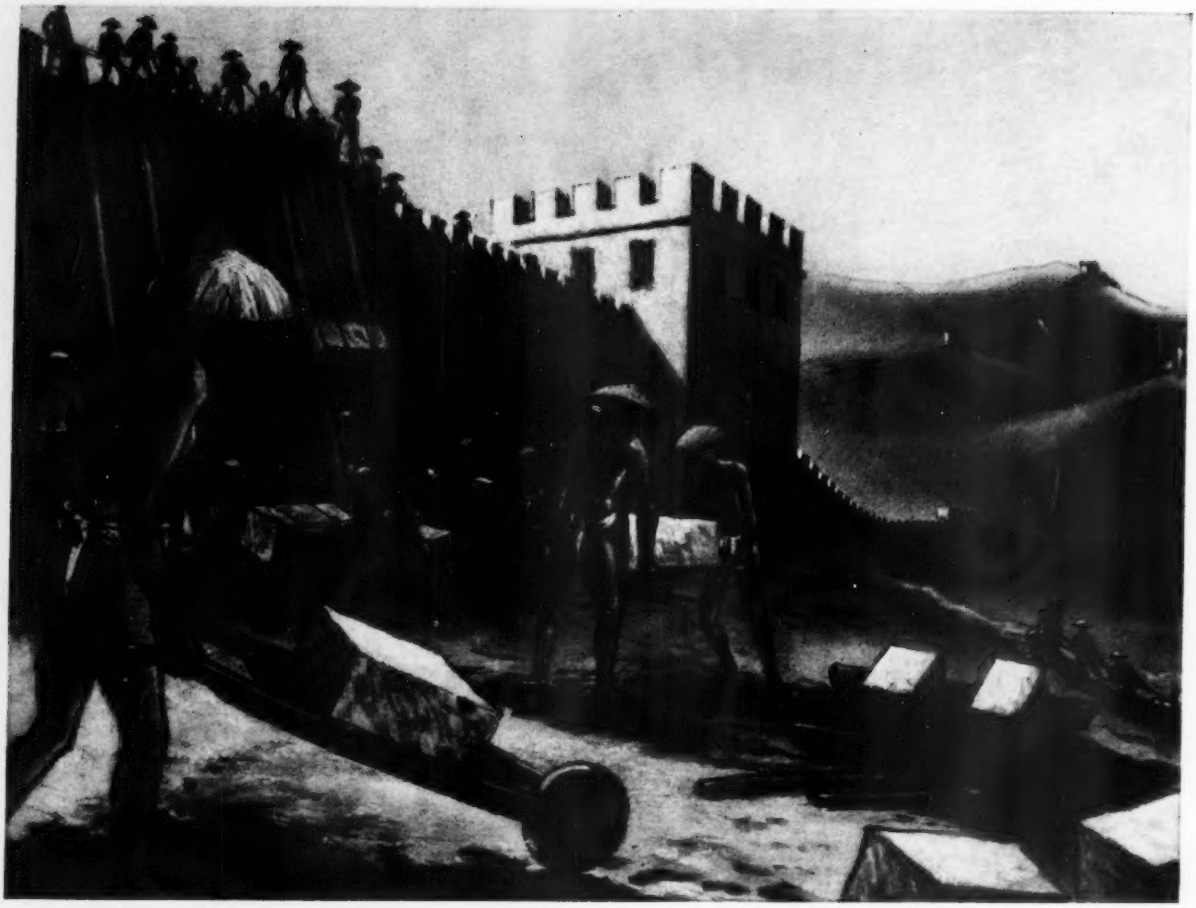
CONTENTS

CATWALK OF ALUMINIUM EXPAMET, STANDARDIZED ON FUEL TANKERS BY DARHAM INDUSTRIES (LONDON) LTD. THE MATERIAL IS OF LIGHT WEIGHT, PROVIDES AN EXCELLENT NON-SLIP SURFACE, AND REQUIRES NO MAINTENANCE

Published the second Wednesday in every month
by ILIFFE & SONS LIMITED
*Dorset House, Stamford Street, London, S.E.*1
Telephone · Waterloo 3333 (60 *lines*)
Telegrams · Sliderule, Sedist London
The annual subscription inland and overseas
is £3 0s 0d *including the special number*
Canada and U.S.A. $8.50

BRANCH OFFICES
Coventry · 8-10 *Corporation Street*
Telephone · Coventry 25210
Birmingham · King Edward House, New Street, 2
Telephone · Midland 7191
Manchester · 260 *Deansgate,* 3
Telephone · Blackfriars 4412 *and Deansgate* 3595
Glasgow · 26B *Renfield Street,* C.2
Telephone · Central 1265

VOLUME 49 **NUMBER 3** **MARCH 1959**



Editor T. K. Garrett, A.M.I.Mech.E. A.F.R.Ae.S.
Editorial Staff F. C. Sheffield (Associate Editor)
A. Baker, B.Sc., A.M.I.Mech.E.

DESIGN MATERIALS **AUTOMOBILE ENGINEER** PRODUCTION METHODS WORKS EQUIPMENT

Engineering Education

As engineering tends to become increasingly complex, so also, of course, do the requirements for training engineers. In fact, during the last twenty years, the rate of progress in industry has outstripped that of the training establishments. The reason for this is probably that, whereas in industry considerable resources have been devoted continuously to research in fields relative to production and design, commensurate effort has not been devoted to the study of the broad principles and fundamental problems of the techniques of education to meet industry's requirements.

It is, of course, widely appreciated that among the prime attributes necessary for a successful career in engineering, whether in the design, research or production spheres, are a thorough knowledge of the fundamental principles applicable to the work undertaken and, above all, the ability to think analytically and constructively. In addition, when the engineer takes over an executive position, he may find himself in control of a very large team, and his success or failure depends to a large extent on his ability to organize and lead that team and to obtain the willing co-operation of each individual in it.

A new approach to technical education seems to be necessary. Although instilling a sound knowledge of the fundamental principles is still a main requirement, more should be done to train students in exhaustive analytical methods of approach on a broader basis than hitherto, and emphasis should be placed on the application of fundamental principles to practical problems. Training in respect of human relationships in industry tends to be left to post-graduate courses, since it is difficult to fit any extra subjects into the already overcrowded syllabuses of earlier training. However, unless manufacturers are prepared to release more people for post-graduate training, some aspects of this subject ought to be in earlier courses.

Closer co-operation between the apprentice schools, universities and technical colleges would go a long way towards making good the current deficiences in respect of technical education. The sharp division of training between attendances at local technical colleges, to learn the fundamentals, and the apprentices' programme in the works, where the more practical aspects are taught, tends to encourage in the minds of those who have so recently left school, the belief that the training in the factory is real engineering and that the fundamentals are just an extension of the dreary learning of their school days, which, in many instances, they really would be only too pleased to forget.

It is suggested that both the narrowing of the gap between the practical and theoretical aspects of engineering training, and the encouragement of an analytical approach to engineering problems could be achieved by including in the apprentices' training, a course devoted entirely to the practical application of the basic principles learned at the technical college. Executives of the various design, research and production departments in the firm might furnish examples of actual problems that have been solved by these departments, so that they can be put before the apprentices in as realistic a manner as possible. The method of presentation of the problems should be a complete break with the traditional practice of setting questions framed so as to include only the data relative to them, and these exercises should not necessarily be relevant only to a simple fundamental conception that the apprentices have just learned. Further benefit could be derived by analysing different methods of solving the problems and determining which solution is the most economical and best from all points of view.

Training in respect of human relations can perhaps be undertaken more readily in the education establishments than in the industry. Courses should be designed to instruct the student as to how he should set about obtaining the willing co-operation of his colleagues and subordinates as he rises to more senior positions. They might include a series of lectures on certain aspects of psychology, the effects of environment, both in the factory and outside, and many other aspects of personnel management.

So far as improvement of methods of technical education is concerned, the whole subject merits careful study, not simply as a spare-time project for educationalists already fully occupied with other duties, but as a major research project requiring to be pursued for at least several years. The team to carry out the work should comprise a minority of engineers and teachers, otherwise there would be a danger of its being too much influenced by traditional practices; it might well include a number of sociologists. Expert medical advice should also be sought in connection with the curricula for courses on the human aspects.

It is becoming widely recognized that progress in respect of technical education is a matter of extreme urgency, and that positive action is necessary to remedy the deficiencies of the current system. Industry will derive considerable benefit from the better training of engineers, so it would be to the advantage of industrialists to take the lead and press for a proper investigation and appropriate action. The penalty for failure to do so will be a continued shortage of trained engineers of real value and also of suitable recruits for executive positions in all spheres of industry.

HOBBS MECHA-MATIC TRANSMISSION

Basic Principles and Constructional Details of a System Having a High Mechanical Efficiency

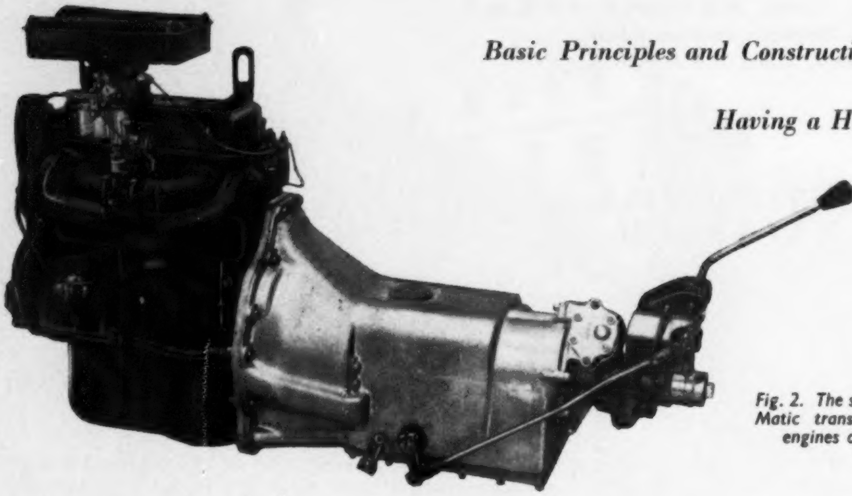


Fig. 2. The smallest of the range of Hobbs Mecha-Matic transmission units is designed for car engines of 900 to 1,300 cm³ swept volume

WITH many years of experiment and development behind it, the Hobbs automatic transmission system has reached a point where Hobbs Transmission Ltd., of Sydenham House, 78 Russell Terrace, Leamington Spa, has felt justified in designing a number of units of different sizes and types, to suit a fairly wide variety of vehicles. It is noteworthy that these incorporate only two features that are at all new to the Hobbs designs, and both these changes are the outcome of logical progress and thought on sound technical lines. One is a modification to the clutches, and the other provides for starting in first gear in all circumstances.

Before discussing these and other features in detail, however, it may be helpful to outline the reasoning that is the basis of the Hobbs system. In Europe, as distinct from America, the small car always has had firm public support, and in recent years this popularity has strengthened. It is natural therefore that a British design, such as the Hobbs unit, should have been evolved with small vehicles very much in mind, although not to the exclusion of its application to larger vehicles, which also form an important part of the European industry. In short, a European transmission system should be such that, with suitable dimensions, it can handle very high torques and powers. On the other hand, it should not embody any feature which makes it dimensionally or otherwise unsuitable for applications in which it is required to transmit smaller torques.

These considerations, among others, account for two outstanding features in respect of which the Hobbs transmission differs from most others. Where automaticity is wanted in a transmission system, some form of hydraulic drive, either of the simple constant-torque-ratio fluid coupling type or the more elaborate hydraulic torque converter, is generally employed. The Hobbs has neither. A second feature found in most recent automatic transmissions is epicyclic gearing, because the frictional engagement of the gears of such a system lends itself well to automatic control of ratio changing. Although the Hobbs unit, incorporates this type of gearing, Fig. 1, it does not have the ring gears that are so widely, but erroneously, thought to be essential parts of epicyclic trains.

The reasons for the omission of these features from the Hobbs transmission are simple. In hydrodynamic power transmitters of the kind commonly known as fluid couplings or hydraulic torque converters, the highest input torque that can be handled by a given layout varies in proportion to the fifth power of the diameter of the coupling. A result is that if the design torque is, for example, halved, the diameter can be reduced by only 12½ per cent. On the usual approximation

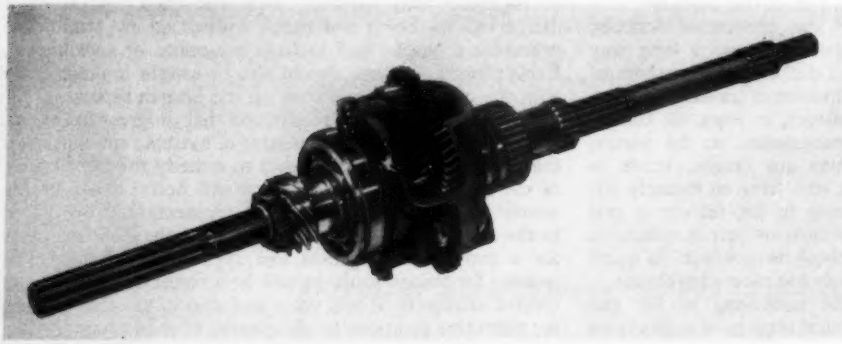


Fig. 1. The epicyclic gear train assembly used in the Hobbs transmission does not incorporate any annulus gears and drums

that the weight of similar structures varies in proportion to the cube of a linear dimension, a further result is that when the torque capacity is reduced by half, the weight is reduced by only one third. In practice, such factors as the minimum practicable wall thickness are apt to tip the scales still further against the small unit.

A second, scarcely less important disadvantage of that type of transmission for small powers is its unfavourable mechanical efficiency. This, briefly, is lower than the efficiency commonly attained by purely mechanical transmission. It may be that if plenty of power is available, some power loss can reasonably be accepted for the sake of obtaining other qualities, but this is not attractive when the engine is only just big enough to provide the power that is essential for normal purposes. Also, since power loss means fuel wastage, the owner of a small and potentially economical vehicle is unlikely to welcome any device that reduces the miles per gallon obtainable.

The absence of ring gears is less a matter of some undesirable scale effect than of the need to make the design as compact as possible to fit conveniently into a small vehicle. Perhaps even more important, the arrangement chosen has the merit of relatively low pinion speeds. These speeds naturally depend on the ratio in use. In first or reverse, the pinions rotate at about three-quarters of engine speed; in third gear they rotate at about a fifth of engine speed; and in top, they do not rotate on their spindles at all. Further, the planet cage always revolves more slowly than the engine, except in direct drive, when the two speeds are equal.

One other feature of the Hobbs system must be mentioned at this stage. As will be seen later, gear engagement is not simply a matter of applying a brake to this or that section of the box, as in so many epicyclic arrangements. Instead there are also two clutches, the distinction here being that whereas a brake holds some part stationary, a clutch causes it to rotate. Neutral is in fact obtained by disengaging both these clutches, while leaving the gears connected to the output shaft. A result is that the Hobbs gearbox is entirely at rest when in neutral with the vehicle stationary. Consequently, there is none of the whine that is familiar with some forms of epicyclic box.

Range of Units

Hitherto, most descriptions of the Hobbs unit have related to one particular size. Now the Mecha-Matic transmission, which is so named to indicate that it is mechanical and automatic, is available in some ten different designs, each of which can be supplied with a variety of gear ratios, provided that the numbers required are sufficient to justify quantity production.

The smallest unit, Figs. 2 and 3, is intended for any engines of 900 to 1,300 cm^3 and can accept a torque of 70 lb-ft, with close ratios such as 3·60, 2·195, 1·405 and 1 : 1, and a reverse of 5·40 : 1. However, a torque limit of 60 lb-ft is preferred with wide ratios such as 4·46, 2·425, 1·46 and 1 : 1, and 6·54 : 1 reverse. The weight of this transmission complete with clutch is 97 lb. Next comes a size suitable for engines of up to 2 litres swept volume, with a torque capacity of 90 lb-ft. Representative ratios are 3·89, 2·22, 1·49 and 1 : 1, and reverse 4·86 : 1. The weight of the complete unit is 120 lb.

A third size, intended for large cars, light commercial vehicles and taxi-cabs with petrol or diesel engines, has a torque rating of 110 to 180 lb-ft, according to the ratios chosen. The closest ratios quoted for this box are 2·935, 1·895, 1·35 and 1 : 1, with 4·50 : 1 reverse, but much wider ratios also are available. This unit weighs 140 lb complete with clutch. Also for cars and commercial vehicles, and capable of taking a maximum torque of between 150 and 200 lb-ft, there is a unit weighing 160 lb complete with clutch. This, too, can be made available with a variety of alternative ratios.

Two designs have been evolved for public service vehicle applications. One is a self-contained unit weighing 540 lb with the clutch. It is suitable for mounting separately on the chassis, somewhere between the engine and the final drive unit, and has a torque capacity of 500 lb-ft. The other unit is for mounting on the engine: it weighs 450 lb and the torque capacity again is 500 lb-ft. Both types could be applied to light locomotives and railcars as well as buses and coaches.

All the foregoing Hobbs designs have four forward ratios and one reverse. Another, intended for dumpers, has five forward ratios, and should be used in conjunction with a forward-and-reverse gearbox so that all five ratios are available in both directions. Here, again, the torque capacity is 500 lb-ft. This unit is intended for manual selection and has a power take-off point for tipping or other purposes. Complete with clutch, but without reverse unit, it weighs 850 lb.

A similar but smaller box is available for tractors, whether wheeled or track-laying. This also has five ratios, with manual selection; its torque capacity is 350 lb-ft and its weight, with the clutch, is 360 lb. There are two other designs. One, for shunter locomotives of up to 250 h.p., is automatic and has four ratios. Hobbs clutches are available to provide the forward and reverse shift in the final drive. This unit weighs 1,700 lb, with the clutch but excluding the forward-and-reverse mechanism. Its torque capacity is

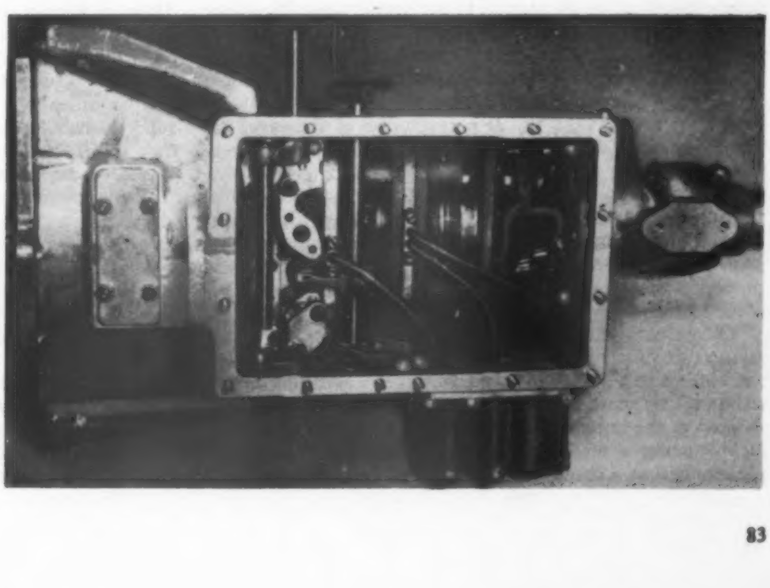


Fig. 3. View of the underside of the Hobbs Mecha-Matic transmission with its sump removed to show the layout of the controls and the gear, clutch and brake assembly

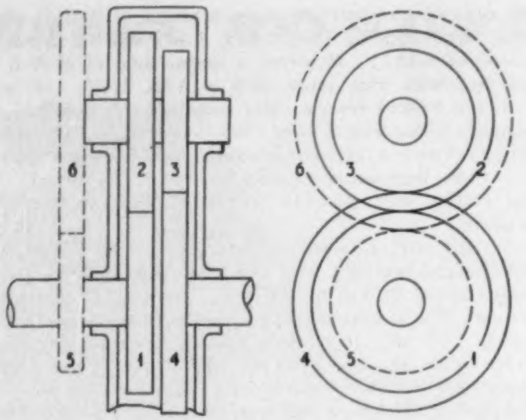


Fig. 4. Diagram showing the fundamental principle of operation of an epicyclic gear train without ring or annulus gears and brake drums

1,100 lb-ft. The other is an industrial two-speed unit that provides, besides a very smooth take-up in low gear, a power-sustained change into high gear. There is also provision for "inching". The torque capacity is 30 lb-ft and the unit weighs 80 lb.

All the foregoing designs exist, and it is understood that several others are in various stages of preparation and development. Further, Hobbs Transmission Ltd., which is a member of the B.S.A. Group, is prepared to design special units for particular applications that may not be entirely suited by any of the existing designs.

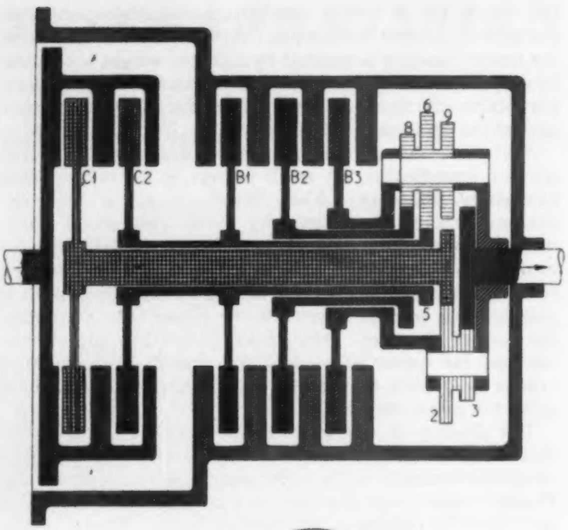
Epicyclic Gears

The principle of operation of an epicyclic gear that has no ring or annulus is shown in Fig. 4. In this diagram, the input shaft is shown carrying a pinion 1 meshing with a gear 2 fixed on a shaft which also has fixed to it a gear 3. This in turn meshes with a gear 4 fixed to the output shaft. The shaft that carries gears 2 and 3 is itself carried in a frame, or cage, which can rotate about the input and output shafts. If this cage is held stationary, the mechanism functions in a manner similar to that of a simple layshaft gear. When the input shaft and the gear 1 rotate, the gear 4, driven by the gears 2 and 3, rotates in the same direction but, if the general proportions are as shown in the diagram, at a lower speed.

On the other hand, if the cage be free to rotate, and there is any resistance to the motion of the output shaft, the latter will not move, but gear 1 will drive 2 and with it 3, which will travel round gear 4, carrying the frame or cage with it. This action is much the same as that which occurs in a conventional epicyclic train when a planet orbits inside the ring gear, except that, for each revolution of the cage, the planet makes fewer turns in travelling round the sun gear than it would do within a necessarily larger ring gear.

Suppose, next, that some clutch arrangement permits 1 to be coupled directly to 4. The result, obviously, is a direct drive from the input to the output shaft. Because the gear ratio between 1 and 2 differs from that between 3 and 4, the planets 2 and 3 cannot turn in their cage and the whole assembly must revolve as a solid unit.

The same result can be obtained, without a clutch or connection of any sort directly between 1 and 4, by means of the two gears 5 and 6, illustrated by the broken line in this diagram. Of these two gears, 5 is arranged so that it can be dogged to the input shaft, and 6 is fixed to the planet shaft. If 5 is engaged with the input shaft, it tends to drive the planet shaft at a speed different from that at which 1 and 2



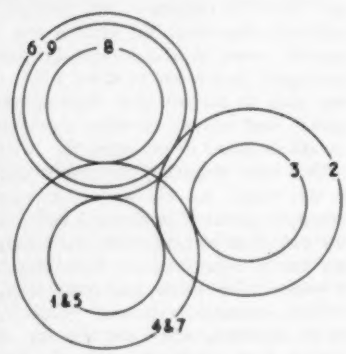


Fig. 5. The diagram above shows the basic arrangement of the gear trains, brakes and clutches of the Hobbs transmission

Fig. 6. On the right is a line diagram representing the meshing of the gears of the transmission system illustrated in Fig. 5

are tending to drive it. Consequently, the mechanism locks and the planet shaft will not turn at all. This means that 3, also, cannot turn and therefore 4 is carried round solidly with the rest of the assembly just as though it were actually connected directly to 1.

Principle of operation

Thus it can be seen that the basis of the Hobbs gearbox is simple, but in practice the arrangement is slightly more complex. However, the action can be followed without difficulty from Fig. 5, which shows the scheme in elevation. There is also an end elevation diagram of the gears, Fig. 6, with similar identity numbers for the various parts.

At the left in Fig. 5 are shown two clutches C1 and C2, by means of which the engine flywheel can be connected to one or other of two components. Clutch C1 drives the solid mainshaft, and clutch C2 drives a sleeve surrounding that shaft. Brake B1 also is coupled to this sleeve which therefore can either be driven at engine speed or can be held stationary. Brake B2 is similarly connected to a second sleeve surrounding the first and brake B3 is coupled to the cage that carries the planets.

So far as the gears are concerned, the arrangement is similar to that of Fig. 4. The gear 1 is fixed to the main or input shaft, 2 and 3 are planets fixed to a common shaft free to turn in the cage, and gear 4 is fixed to the output shaft. In addition, there is a gear 5 fixed to the first sleeve and meshing with 6, which is one of a three-gear cluster of planets mounted in the cage that carries gears 2 and 3. Of these three planets, 8 meshes with the gear 7 fixed to the second or outer sleeve. By virtue of the fact that both the two-gear and the three-gear clusters are duplicated, the other planet 9

meshes with gear 2 in the two-planet cluster. This is illustrated in the end-view, Fig. 6.

The power transmission paths in the various gears are summarized diagrammatically in Fig. 7. Top gear or direct drive is obtained by much the same means as was described in connection with Fig. 4. For this purpose C1 and C2 are both engaged but all the brakes are free. In consequence, gears 1 and 5 are both forced to revolve at flywheel speed. This locks all the planets and compels the mechanism to revolve as one solid block, so that gear 4 and the output shaft are driven at flywheel speed.

For third gear, C1 is again engaged, but C2 is free and brake B1 is applied so that the inner, or first, sleeve and the gear 5 are stationary. As gear 1 revolves, it drives 2 and 3 which, in turn, cause 4 to rotate in the same direction as 1. But this is not all: because 2 is turning, so also is 9; so 6, which is in the same cluster, must travel around the stationary gear 5, carrying the planet cage with it.

Consideration of these successive steps shows that 6 and 9 must rotate in the same direction as the mainshaft and therefore the planet carrier also must revolve in that direction. Consequently, the planets 2 and 3 move in that direction too, and the condition is not that of the simple layshaft gear of our first diagram. Instead, the layshaft itself is carried round the main shaft in the direction of rotation of that shaft and therefore the output shaft is driven faster than it would be in the earlier simple arrangement. This gives an overall reduction of the speed differential as between gears 4 and 1, but not a very great one. The result is in fact third gear.

When second gear is selected, C1 remains engaged and brake B2 also is engaged, but the other clutch and brakes are free. The direct consequence is that pinion 1 still rotates at crankshaft speed and the gear 7 is stationary. As before, 2 and 3 are driven by 1 and therefore tend to carry the planet cage around the output shaft gear 4. But because 9 meshes with 2, the three-planet cluster must rotate in the cage; and because 8 meshes with the stationary gear 7, the planet cage must revolve round the output shaft and its sun gear.

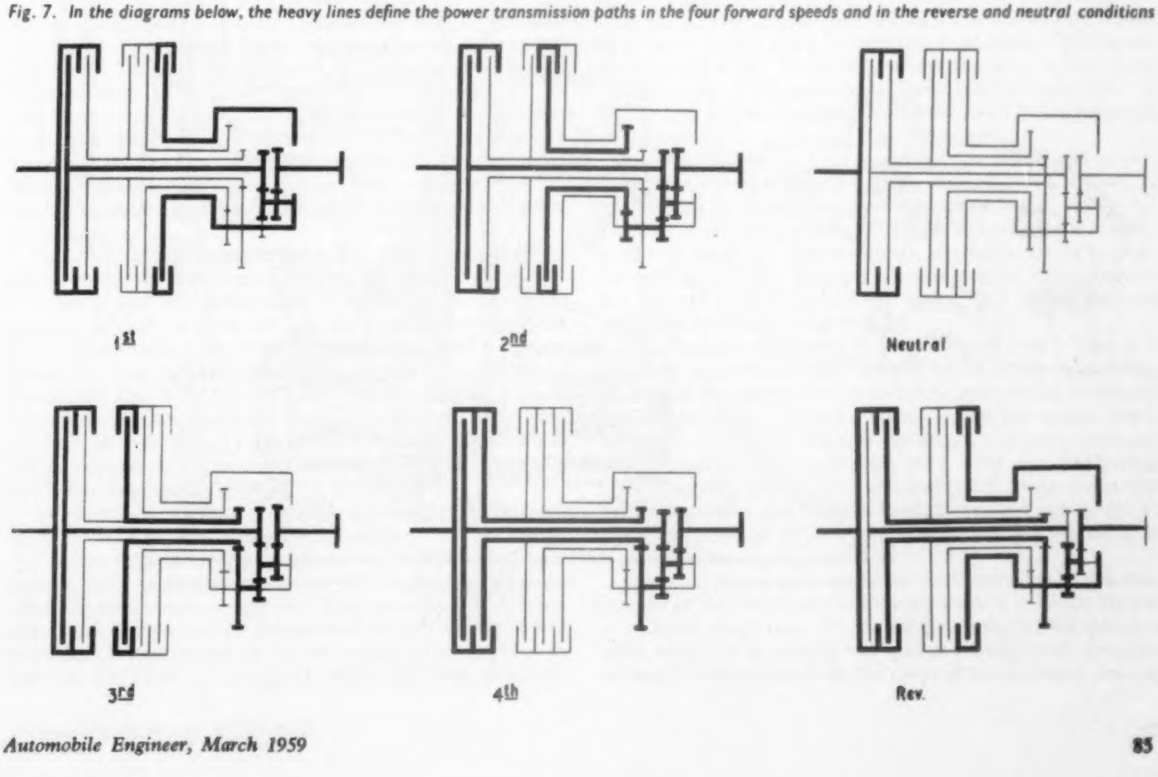
Either of these two actions alone on the planet cage would have merely a neutral effect, leaving the output shaft dead. However, because the two actions interfere with one another, a positive drive is obtained, as follows. Suppose that the flywheel, and therefore pinion 1, turns clockwise as seen from the crankcase. Then 2 turns anti-clockwise, more slowly than 1, and 9 turns clockwise but faster than 2, although still a little slower than 1. Because 8 is integral with 9, and is much smaller than the stationary gear 7, one turn of 8 will take it less than one turn round 7, and 8 itself is already moving more slowly than 1 and the crankshaft. With the proportions shown in the diagram, one revolution of the input shaft will take 8 clockwise about half a revolution round 7. Consequently the planet cage will be carried about half a turn in a clockwise direction round the output shaft.

If the planet carrier were fixed, as in the simple diagram first considered, we know that the output shaft and gear 4 would be driven in the same direction as the input shaft but at a much lower speed. However, instead of being stationary, the planet cage is moving in the same direction as the output shaft, the speed of which must therefore be correspondingly greater: in other words, there is a smaller reduction of speed than there would be with the planet cage fixed. This gives the second gear condition.

First gear is now easy to follow. For this, again, clutch C1 is engaged. Every other clutch or brake is free except B3 which holds the planet cage stationary. This takes us straight back to the conditions of our elementary diagram, the drive being simply through gears 1, 2, 3 and 4 to the output shaft. The result, as we have just seen, is a greater reduction than is provided in second gear.

For reverse, the clutch C1 is released and C2 is engaged. Brake B3 is still engaged, as in first gear, and the other brakes are free. Gear 5 now drives the system by causing 6 to rotate anti-clockwise. Because the planet cage cannot revolve, gear 9 turns gear 2 clockwise and therefore 3 drives 4 anti-clockwise. This is of course the reverse direction from that of the crankshaft and gear 5. It can be seen also that there is a considerable overall reduction because there is

Fig. 7. In the diagrams below, the heavy lines define the power transmission paths in the four forward speeds and in the reverse and neutral conditions



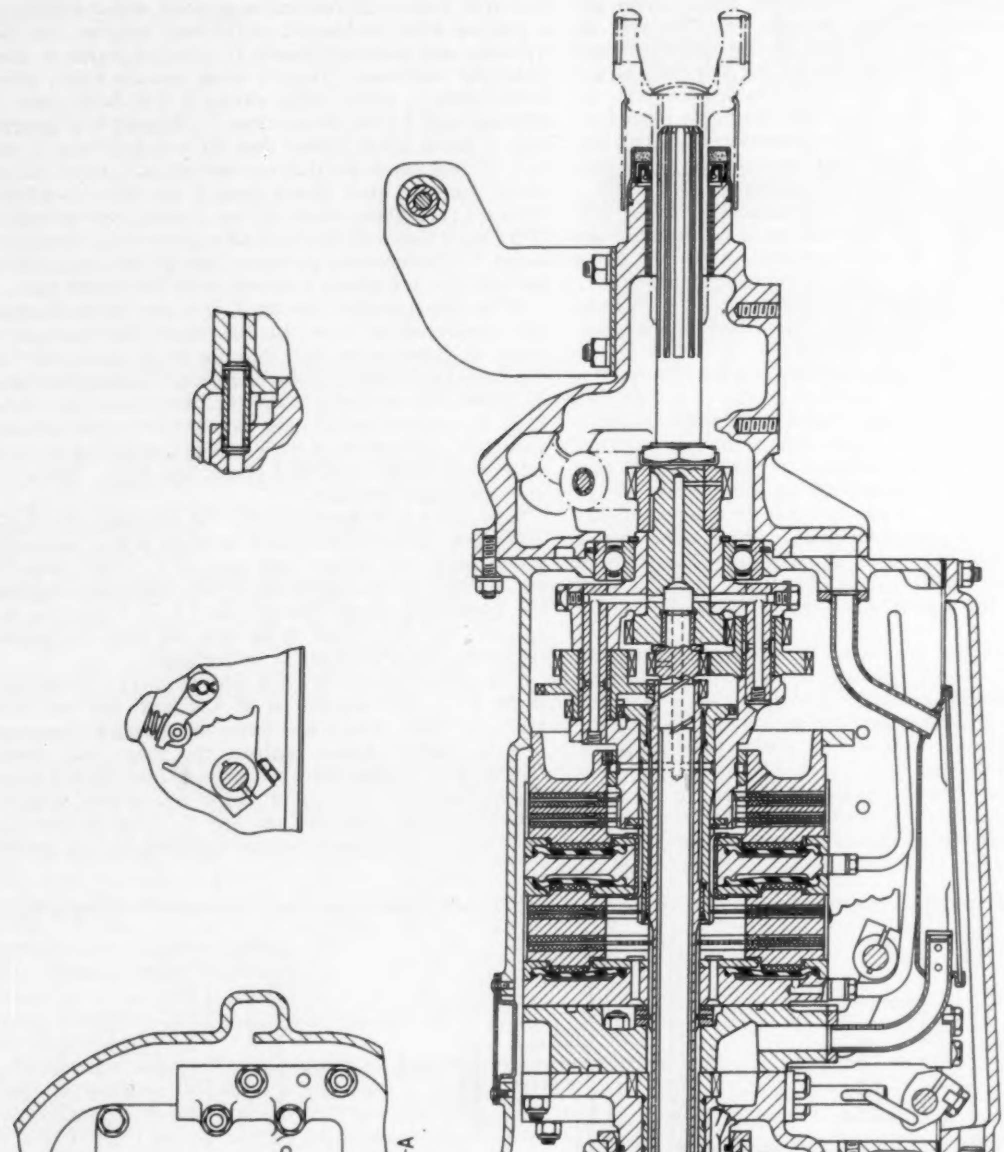


FIG. 8. GENERAL ARRANGEMENT OF A HOBBS TRANSMISSION UNIT FOR SMALL PRIVATE CARS
Alternative gear ratios can be provided for maximum torque outputs of 70 lb-ft or 60 lb-ft

some reduction at each of the stages 5-6, 7-2 and 3-4. In practice, every set of ratios known to have been adopted so far by Hobs has the reverse lower than the first gear, although in one case the difference is very small.

There remains only the neutral condition to be explained. In this condition, all the brakes are free, and since both the clutches also are free, it is obvious that no power can be transmitted. An important feature is that in this condition no part of the gearbox is driven by the engine. Since the output shaft also is stationary, the whole of the gearbox mechanism is at rest and therefore silent, as mentioned earlier.

On the other hand, if the vehicle is in motion, with neutral selected, the output shaft is rotating, and the consequent rotation of gear 4 causes gears 3 and 2, and therefore the input shaft, to rotate. Also, because of the reaction between the teeth of 4 and 3, the planet cage rotates. Many parts of the gearbox will therefore be in motion, but under no load and at speeds lower than when the same components are in use to transmit power.

Detail design

From Figs. 8 and 10, it can be seen that the designs of the two clutches and the three brakes are all based on the well-known principles of the conventional plate type clutch, but with certain differences. The brake B3 is of the two-plate arrangement in order to resist the high torque that it has to transmit in the first and reverse gears. Each of the others has a single plate.

In current Hobbs designs, the friction facings both of the brakes and the clutches, are attached to the spinner plates. At one time, the converse arrangement was employed for the brakes, to minimize the inertia of the spinner plates. Experience showed, however, that with this arrangement there was a tendency for the plate to burn, so the more conventional layout is now followed because with it the frictional material insulates the plate from the heat. Also, heat generation occurs at the face of the pressure plate and the back plate, which are heavier and therefore have a greater thermal capacity. This is one of the two changes mentioned earlier in this article.

Conventional as they may be in their general design, the Hobbs clutches and brakes have a special method of actuation, directly by hydraulic pressure, without the employment of any levers, bearings or plungers. The arrangement can be followed easily by studying Figs. 8 and 10. Between the two clutches C1 and C2 is a casting, which is known as the valve body and which embodies, among other things, passages leading to its front and rear faces. Attached to each of these faces is a flexible diaphragm, that is forced outward from the casting when oil under pressure is admitted between it and the valve body.

To shield this diaphragm from the heat inevitable with any friction clutch or brake, an insulator ring is interposed between it and the pressure plate, which, in the orthodox manner, is used to press the spinner plate against the back plate or front plate, as the case may be. Except for the spinner plates, all these parts of the clutch assembly rotate with the crankshaft and flywheel. In the absence of oil pressure behind the diaphragm, the pressure plate is urged away from the back or front plate by short helical springs, one of which can be seen above C1 in Fig. 8. These springs serve simply to obviate drag when the clutch is not engaged.

As might be expected, several refinements have been introduced in respect of the control of the pressure behind the diaphragm. First, the cavities within the valve body include cells so shaped that some air is trapped in them when the oil pressure is applied. This provides a cushioning effect and ensures gentle engagement of the clutch. When the clutch is disengaged, its air cell is open to atmosphere so that any loss of air is made good, before the next operation.

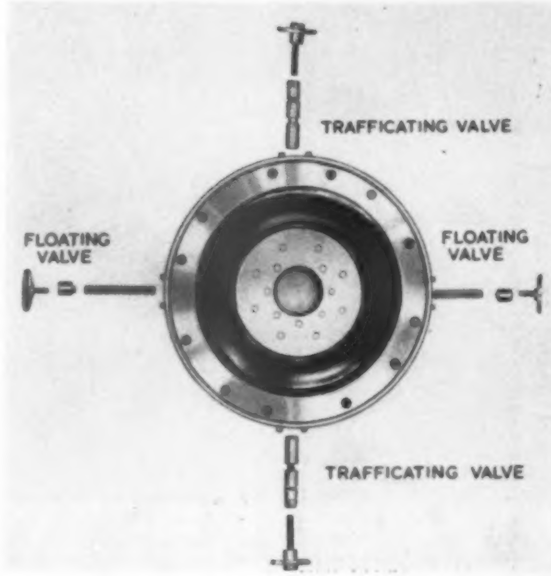


Fig. 9. Among the refinements that have been introduced into the control system, to regulate the pressure applied to the diaphragms that engage the clutches and brakes, are the trafficating and floating valves, which are housed in the casting that is interposed between the two clutches

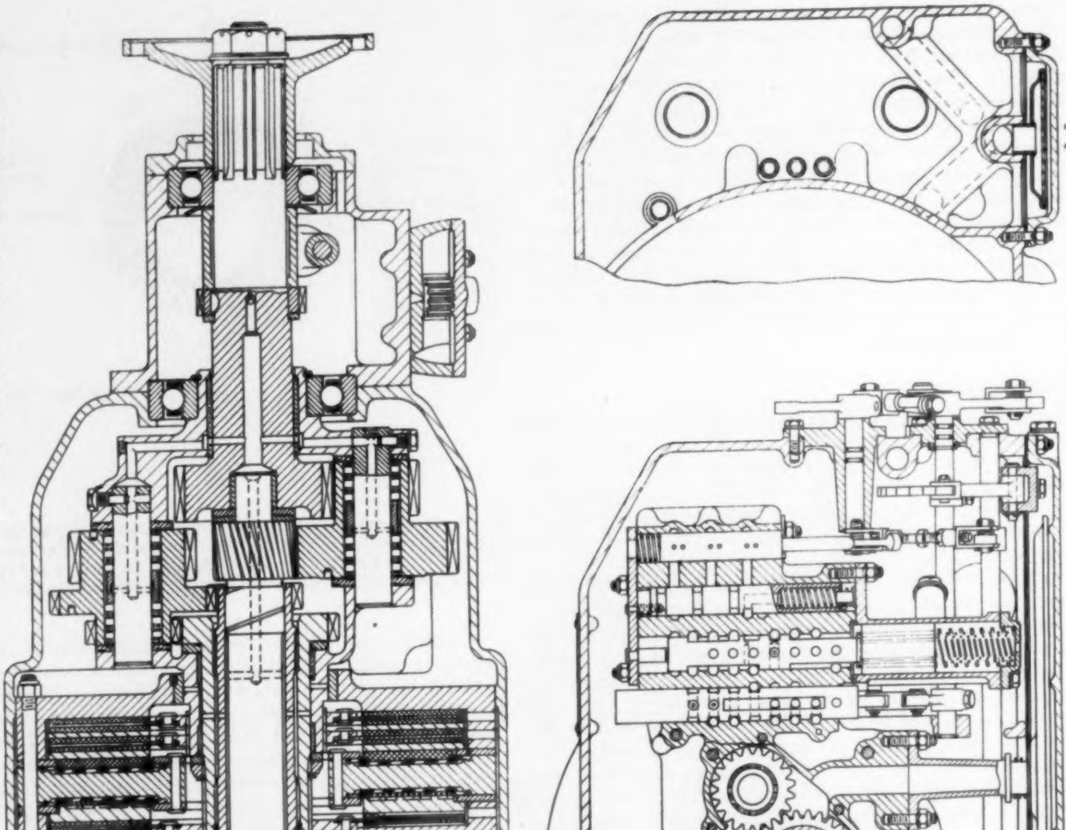
Secondly, also within the valve body, there is what is termed a trafficating valve, Fig. 9, which is a device to simplify the control of the vehicle in traffic. This valve is installed radially in such a manner that while centrifugal force pushes it outwards to its closed position, oil pressure urges it inwards toward its open position. When this valve is open, it releases pressure behind the diaphragm. Therefore, irrespective of the ratio selected by some other part of the automatic transmission, this valve ensures that, when engine speed falls below a predetermined limit, the clutch is free. At low engine speeds, when centrifugal force is correspondingly small, oil pressure opens the valve and allows a reduction of pressure in the space behind the diaphragm. This space remains full of oil, of course, because the valve is kept open only by the fluid pressure. Consequently, any rise in engine speed is accompanied immediately by re-engagement of the clutch.

Thirdly, there is a light spring at the outer end of the trafficating valve to urge it gently inwards. The effect of this spring is negligible by comparison with either oil pressure or centrifugal force, but it becomes useful when the engine is dead. In that condition, the outer spring pushes the trafficating valve right in, not merely to its open position but beyond it so that it closes again, thus permitting the engine to be started by towing.

Still another refinement is the anti-stall port. This is a supplement to the normal exhaust ports of the trafficating valve, and its purpose is to provide an extra outlet in special circumstances, for example, when starting the engine when the oil is very cold. In this condition, excessive pressure might otherwise be developed even with the trafficating valve normally open. The anti-stall port opens when the trafficating valve has moved inwards beyond the point at which the normal exhaust ports open but not so far that those ports are closed again.

At the extreme inner end of the trafficating valve chamber in some of the Hobbs transmissions, there is a device known as an inner drag valve. It is a simple spring-loaded plunger valve, which maintains in the system enough back pressure to keep the clutch faces on the verge of engagement, even at

FIG. 10. P.S.V. TYPE TRANSMISSION
The scrap view on the left shows the dynamo pulley assembly



low engine speeds. This valve is not generally necessary but it is available when the characteristics of a particular transmission design make it desirable.

Also in the valve body is a floating piston type valve, which empties the diaphragm chamber when it is not under pressure. This piston valve, too, is housed in a radial bore, and a low-rate helical spring urges it outwards. The bore housing this valve is actually part of the ducting from the oil supply line to the clutch diaphragm chamber. When oil is fed in, its pressure overcomes the spring and moves the valve inward to the bottom of its housing. Centrifugal force has no effect here because this part of the supply passage is virtually a U-tube with one leg balancing the other. Under pressure, therefore, the floating valve remains in a position which leaves the supply line in communication with the diaphragm chamber. When oil pressure is cut, by operation of the control mechanism elsewhere, the floating valve is forced outward by its spring. This action not only cuts the communication between the oil supply and the diaphragm chamber, so that the passage remains filled with oil, but also opens an exhaust port from the diaphragm chamber to a passage leading to the outside of the valve body, so that oil already in the diaphragm chamber is flung out by centrifugal force. In addition to obviating clutch drag by emptying the diaphragm chamber, this floating valve has a considerable influence on the smoothness of clutch engagement, by controlling the rate of oil admission to the diaphragm chamber when pressure is applied.

From the foregoing description it will have been realized that the single valve body contains two trafficating valves and two floating valves. One of each of these is concerned with clutch C1 and the other pair serves the clutch C2. The two trafficating valves are diametrically opposite one another and the two floating valves are in similar relative positions to one another, but on a diameter normal to that of the trafficating valves. Thus, there is no difficulty in securing proper balance of the valve body as a whole.

The actuation of the three brakes is simpler. This is because one or other clutch is engaged for every ratio, so that smoothness of engagement can be ensured by the clutch mechanism alone. There is, in fact, only one special feature, which is a device to delay the release of a brake when a change is being made to a higher ratio. In this way, something like a power-sustained change can be secured. There are two parts to this device. One is a restriction of the hydraulic exhaust from the diaphragm chamber during upward changes. The other, in parallel with the diaphragm chamber, is a variable-capacity chamber consisting of a cylinder with a floating piston that is urged by suitable springs toward the outlet end of the cylinder. Oil pressure applied to the brake chamber forces this piston down the cylinder, which is thus filled with oil. When pressure is released, it cannot fall completely until the contents of the cylinder have been discharged through the restricted exhaust port.

Two gear type pumps generate the hydraulic pressure required to control the clutches and brakes. One of the pumps, driven by gearing from the output shaft, is not clear in Figs. 8 and 10, but can be seen in Fig. 12. The other, Fig. 11, is driven by the clutch unit and is housed between that unit and the brake assembly. The system that it serves includes a feed journal supplying oil to the clutch unit, a governor valve and a manual selector valve to direct the pump output to the clutch and brake required to be engaged.

This duplication of the pumps is not merely a safeguard: each has its own special functions. The rear pump serves two purposes: since its output varies with the road speed, it is used to furnish the appropriate signal to the control mechanism. Secondly, it provides operating pressure when the engine is dead, thereby enabling the appropriate clutch

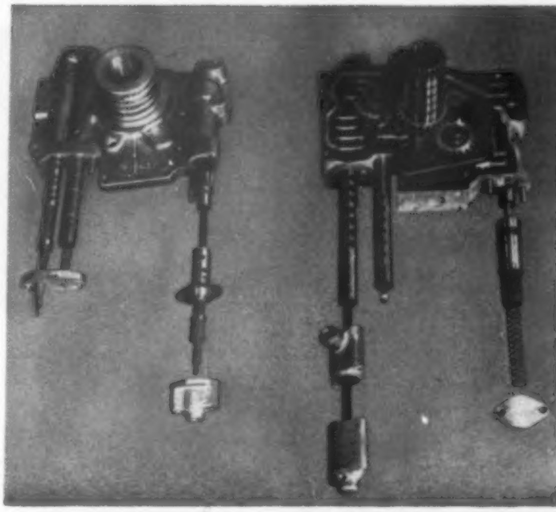


Fig. 11. Illustration showing the arrangement and various components of the hydraulic unit for a transmission designed for 1½ to 2½ litre engines. The function of the pump in this unit is simply to supply adequate quantities of oil to operate the control system while the engine is running; two pressure relief valves are incorporated, one to regulate the pressure supplied to the clutches and the other to regulate that supplied to the brakes that are employed to effect the gear changes in the transmission

and brake to be engaged for tow starting the vehicle. The speed of the front pump is always directly proportional to that of the engine. Therefore, the function of this pump is simply to supply adequate oil to operate the controls whenever the engine is running. Two pressure relief valves are incorporated in the pump, one controlling the maximum pressure exerted in the clutch unit, and the other regulating that supplied to the brake unit.

The governor valve has the duty of converting the road-speed signal from the rear pump into effective action in the control system, which is embodied almost entirely in the central hydraulic unit that includes the front pump. Output pressure from the rear pump is applied to one end of the plunger of the governor valve, and movement of the plunger under the influence of this pressure is resisted by a spring. Consequently, the axial position of the plunger at any moment is a direct interpretation of the road speed of the vehicle.

This last remark must be qualified in one respect. Parallel with the governor valve is another valve operated by linkage from the accelerator pedal. This is in effect a kickdown valve, but it can take either of two forms. In one, it is closed when the throttle is closed, and is opened in proportion to throttle opening. In the other form, it remains closed until the throttle is wide open, and is opened only by further movement of the pedal beyond the full-throttle position. In each case, when open it reduces the pressure supplied by the rear pump. In other words, at any given road speed, the governor valve is affected less if the throttle is open than if it is closed.

The governor valve itself, Fig. 13, has radial ports disposed along the length of its bore. These ports are connected to the brakes and the clutch C2. Clutch C1 is engaged for all forward gears. The first port, for instance, directs the main oil supply to brake B3, so that bottom gear is obtained. When the governor valve plunger moves further, the oil supply is directed through the second port to brake B2 instead of B3 so that second gear is engaged, and so on.

In the hydraulic unit, there is also a selector valve controlled manually from the steering column. On the central quadrant there are six possible positions for the lever; in only one of

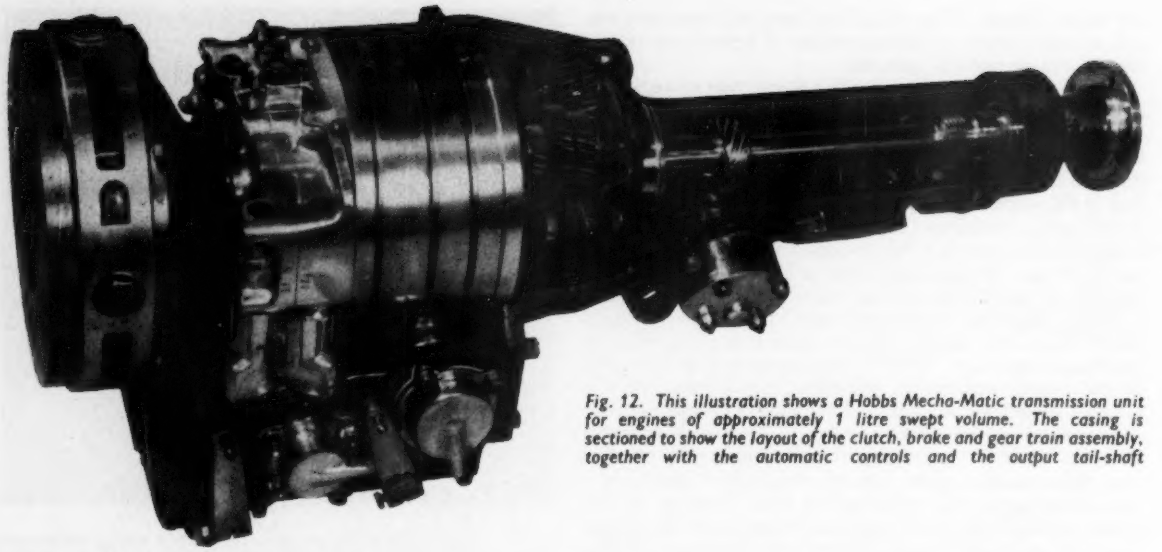


Fig. 12. This illustration shows a Hobbs Mecha-Matic transmission unit for engines of approximately 1 litre swept volume. The casing is sectioned to show the layout of the clutch, brake and gear train assembly, together with the automatic controls and the output tail-shaft

these is the governor valve permitted entire control, and even then it is, of course, subject to the influence of the kickdown valve. With the selector lever in any other position, the selector valve takes over some or all of the governor valve's duties.

Partial control by the selector valve is given by placing the lever at position 1, 2 or 3. This prevents automatic upward changes beyond first, second or third gear respectively, but permits normal automatic operation below the indicated ratio. Reverse gear operation is virtually completely controlled by the selector, when the lever is placed in the R position, except that if this is done while the vehicle is travelling forward, reverse will not in fact be engaged until forward motion has practically ceased. In the N position, the selector overrides the automatic control completely, by ensuring that the transmission is in neutral.

Another valve in the hydraulic unit operates when the vehicle is tow started or, of course, started by running it downhill. In this condition, governor actuation is not needed, but the entire output from the rear pump is required for clutch and brake operation, because the engine-driven front pump is inoperative. The tow-start valve makes the necessary diversion of the rear pump output.

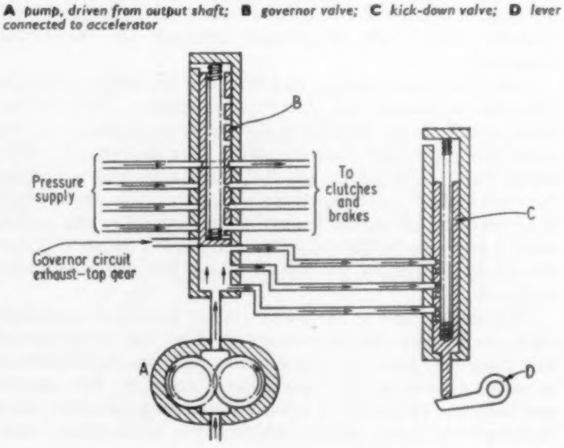
The main body, or housing, of the hydraulic unit consists of two castings, with a plane joint between them. Many of the passages are in the joint face where they can be accurately formed. Others are drilled from that face into one casting or the other. All the valve bores are parallel with the joint; there are three in one casting and three in the other. The front pump housing also is part of this unit: the pump gears are in cavities in one casting, while the other casting acts as a cover plate, Fig. 11.

At one time, the automatic start from rest was made always in second gear. A start in first gear could be made by manual control if gradient or any other circumstance made this desirable. Although starting in second gear was smooth and satisfactory, there were some cases of clutch trouble and it was suspected that the second gear start was responsible for these. Accordingly, the automatic control was altered so as to provide always for first gear starting. With this arrangement there has been no repetition of the clutch trouble, and it has now been embodied in all Hobbs transmissions. This is the second of the two alterations mentioned earlier in this article.

On the road, the Hobbs Mecha-Matic transmission appears to do all that is claimed for it. Each downward change is made at an appreciably lower speed than the corresponding upward change. This avoids the hunting from one ratio to another when the vehicle is driven at a gear-changing speed. Whether full automatic control is selected at the steering column quadrant, or whether the choice of ratios is deliberately limited by the driver, clutch engagement and gear selection within those limits is always completely automatic. These operations certainly appear to be performed smoothly and positively. Moreover, it seems to be impossible to make the gearbox do anything inappropriate. For instance, the selector lever may be placed at 1 or even at R with the car travelling forward at high speed but nothing occurs inside the gearbox until the road speed has dropped to a suitably low value in the one case or has virtually ceased in the other. Then the selected gear is engaged sweetly. When making this test with the lever at R, one is impressed by the spring-buffer effect as the road speed changes from positive to negative with no apparent pause at zero. This might not surprise many drivers used to some form of hydraulic drive, but it does seem to be an achievement in a transmission that, apart from its control, is entirely mechanical, so far as take up and gear changing are concerned.

Fig. 13. In the governor valve, the ports are disposed radially along the length of the bore, and they are connected to the brakes and to the clutch 2: clutch 1 is engaged for all four forward gears

A *pump, driven from output shaft;* **B** *governor valve;* **C** *kick-down valve;* **D** *lever connected to accelerator*



NEW MERCURY ASSEMBLY PLANT

The Thirteenth Post-war Assembly Plant for Ford (U.S.A.) is the Fifth for Mercury Cars

SITUATED at Rivera, about eleven miles south-east of Los Angeles, California, this new plant replaces a Mercury car assembly plant built as recently as 1948 at Maywood, about five miles away. It is one of thirteen assembly plants built and equipped by the Ford organization since the end of World War II as part of its vast modernization and expansion programme. The plant is the fifth for the assembly of Mercury cars and is located to serve thirteen states in western U.S.A. and also Alaska and Hawaii. A total of 31·8 acres of covered floor space is distributed in 13 buildings spread over the 200-acre site. The main assembly building, 1,150 ft long and 765 ft wide, has a partial second floor of 222,750 ft^2 occupied by painting and stoving equipment.

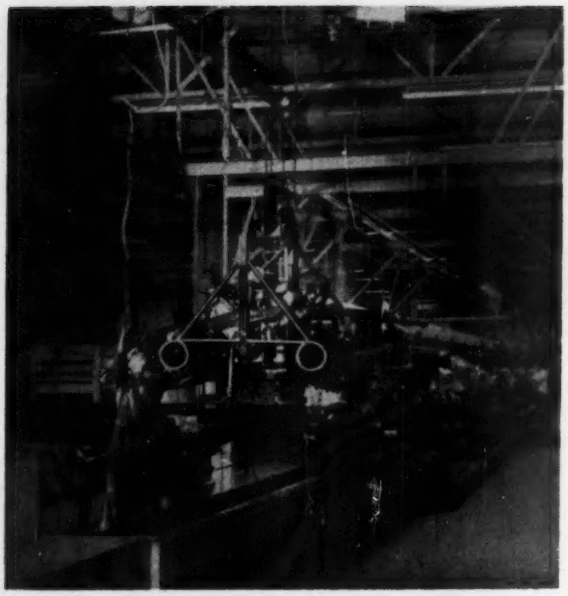
Production rate in the new plant is 35 cars per hour, that is, 280 cars in an eight-hour shift. Annual production capacity, on a two-shift basis, is 132,000 cars whereas the annual capacity of the Maywood plant, operated on a single-shift basis, was 46,000 cars.

In some industries, mass production means merely the repetitive manufacture of large numbers of components or units of the same product, but in this assembly plant, employing some of the most advanced techniques in the automobile industry, each car is built to individual order. Each car leaving the assembly line embodies a choice of 22 body styles, of 16 basic colours, and of 33 different varieties of upholstery and interior trim. At any given time there are 800 cars in various stages of completion and it is possible for each of these 800 units to be different from all the others. If additionally such accessories and optional equipment as power brakes, power steering, air conditioning, radio antenna, and others are taken into consideration, the possible permutations are still further extended.

The complete system of floor conveyors was supplied by the Link-Belt Company, Ewart, Indianapolis. It comprises some 150 conveyors of various types, running for a total distance of 3½ miles throughout the plant, and 135 items of related equipment such as turntables, transfer tables, live roll and lift tables, gravity roll and lift tables, and body elevators. All this equipment is integrated into a vast, continuously operating production aggregate feeding component items from department to department and completed sub-assemblies in correct sequence to the final assembly line. Only few of the conveyors are used merely for transportation from one location to another; the majority carry material through cleaning, finishing, painting, drying, assembly, or other operations. All movements are precisely scheduled

Traffic through the first half of the trim department is controlled from this master control console. It is the operator's job to transfer bodies from one operation to another. Ten pushbuttons at front of panel control live roll and lift tables which lift body from side transfer conveyor and move it at right angles on to one of the trim or storage conveyors

Mercury chassis are built up with front and rear suspension and the transmission line on this chain conveyor, 225 ft long. When the conveyor is run at full speed, this part of the assembly takes 30 minutes



The chassis is completed on this conveyor, 290 ft long, and is then transferred by overhead monorail to the final assembly line, from which it will be discharged in 59 minutes as a nearly finished Mercury, ready for the test track

and co-ordinated by means of a tele-typewriter system. The order for each individual car, which is transmitted to all departments, specifies the body style, colours, engine, and upholstery, and also lists the accessories required.

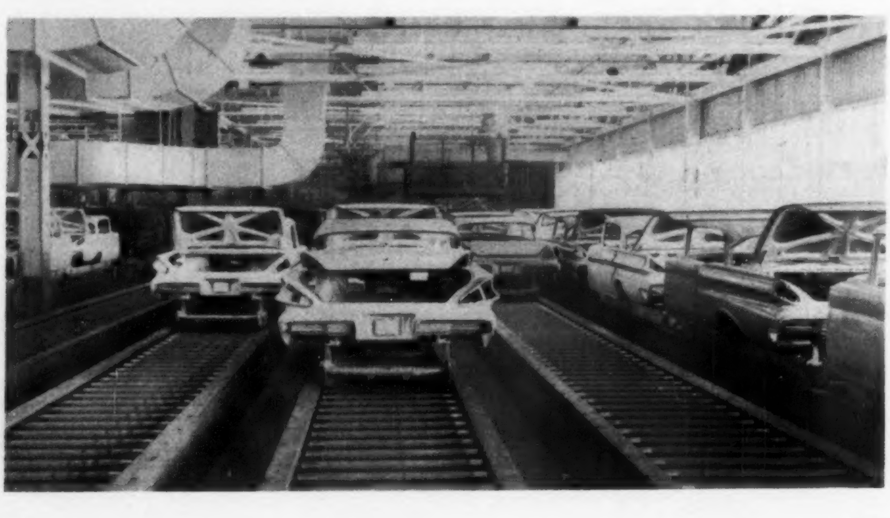
Sixty railway car-loads of parts and materials will be required each day when the plant works up to full capacity production. Two railway tracks run the entire length of the south side of the building, and 36 freight cars can be accommodated inside the building at one time. In addition, 16 trucks can be unloaded simultaneously inside the building. Trains of freight cars are marshalled outside the plant in such a way that when brought into the plant each car can be unloaded near the area where the particular materials or sub-assemblies carried are stored. Engines, for example, are unloaded near the western end of the plant while body pressings are unloaded near the eastern end. Material is held available for direct withdrawal by the production operators on a minimum of four hours' supply of bulky parts and a minimum of eight hours' supply of smaller items.

Assembly of the body is started first, since that is by far the longest operation. After the body has been built up, it is transferred to the second floor for painting. On return to the first floor, it is trimmed with chrome items, glass and door furniture and is then moved to the 90-car storage area ahead of delivery to the final assembly line. On the final line it is set down upon the particular chassis specified by the tele-type order. As the car goes down the line, front-end assembly, wheels, and other components are added, all according to the order instructions. When the car reaches the end of the final assembly line, the engine is started up and the car is driven out to a quarter-mile test track located at the east end of the assembly building. This track permits operational testing of all cars.

After the test run, the car is brought back to the pre-delivery preparation section, where small repairs are effected, paint is touched-up if necessary, seat cushions are installed, and the car is given the final inspection and a finishing operation. About 3½ days are required for this assembly cycle. A large part of this time, however, is spent in body assembly, painting and trimming. Actual time of assembly from bare frame to finished car is just 2 hours and 46 minutes when the system is operating at the normal capacity rate.

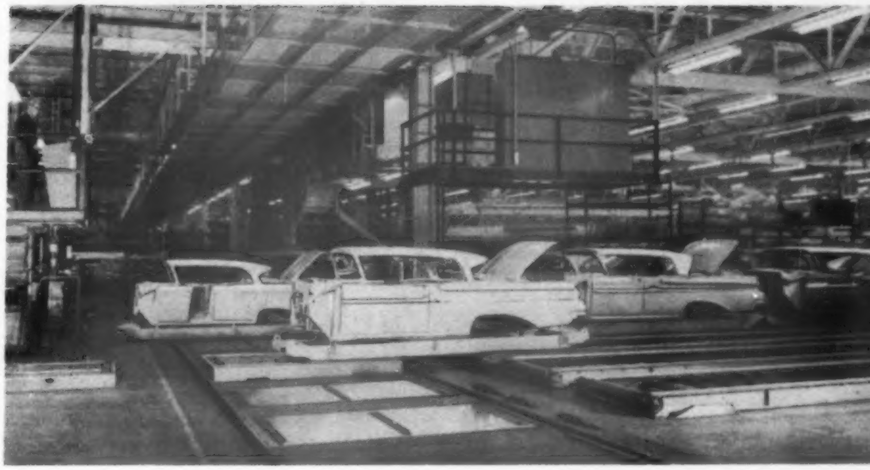
Refinements over previous plants from the materials-handling standpoint, include a higher degree of automatic handling, better timing, and improved space arrangements. Automatic transfers play an important part in the movement of car bodies and parts throughout the plant. Many of these transfers require neither operators nor push buttons. A body travels along one conveyor to the end, is picked up by a transfer conveyor which carries it laterally at right angles, and is then transferred to a third conveyor parallel to the first, entirely automatically. Where selection of a conveyor is necessary, push button controls permit bodies to be transferred readily to the desired locations. In the body-trim department, for example, a dual-chain, side-transfer conveyor can be set by the operator to perform 32 different transfers, linking together 21 different conveyors. This permits bodies to be routed through pre-trim and electrical lines, No. 1 and No. 2 trim lines, station-wagon trim lines, repair, and other lines, as required.

All painting is done on the second floor to ensure dirt-free application. This also improves working conditions for employees since the paint-drying ovens are separated from the rest of the plant. Bodies "in the white" are lifted to the second floor by elevator. There are four body spray booths on the second floor, for prime coat, first, second and



Painted car bodies are stored on five parallel dual-chain roller conveyors prior to their return to the first floor. This type conveyor can be operated continuously. When a body is blocked by the body ahead or by the end stop, the rollers permit the conveyor to pass beneath the skid which supports the body

This dual-chain side-transfer conveyor can be set by the operator to perform 32 different transfers, linking 21 different conveyors in the trim department. The operator at the left controls half of the system, receiving bodies from second-floor paint shops, routing them through pre-trim and electrical lines, on to storage conveyors and into No. 1 and No. 2 trim lines, where such items as heaters, regulators, all glass except the windscreen, and head linings are applied. Conveyor is 310 ft long and has two drives



third colours. Beyond each is a twin-chamber drying oven in which bodies are carried two abreast on parallel conveyors.

In all, there are 59 floor conveyors on the second floor to carry the bodies through the various finishing processes. The system is arranged so that solid-colour bodies by-pass the third colour track. Finished bodies are stored on five parallel, dual-strand, roller conveyors which permit them to be marshalled for correct sequence prior to being lowered to the trim department on the first floor. The paint shop has specially designed equipment to control the emission of waste into the atmosphere. Large fume incinerators consume the solvent vapours which might otherwise be discharged from the exhaust stacks of the paint baking ovens. They hold the vapour-laden exhaust for a sufficiently long period of time for combustion to be complete.

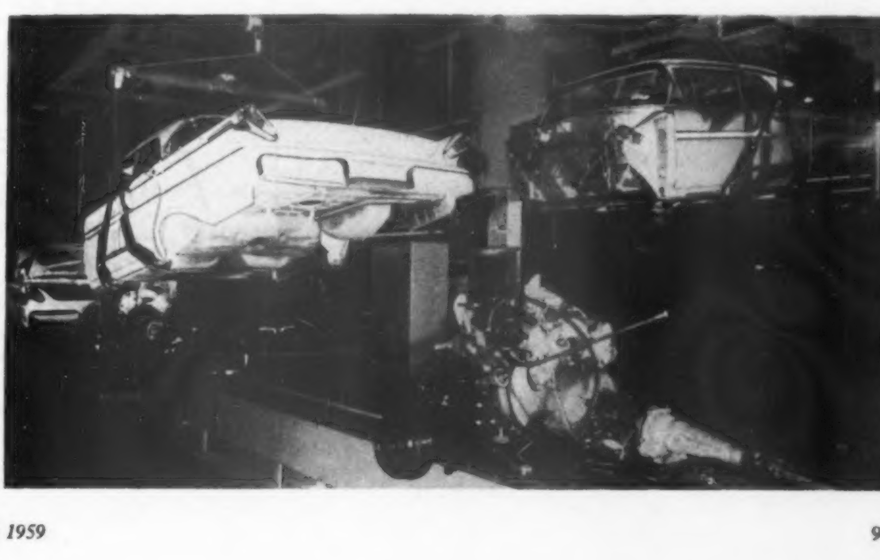
A new arrangement for body storage ahead of the main assembly line permits 90 bodies to be stored on ten conveyors, five on one level and five directly above them. This offers exceptional flexibility in storage and selection. Two body elevators, which operate like "pigeon-hole parkers," stack the bodies into this storage area and remove them at the other end. The elevators travel on tracks which permit them to be positioned in front of the desired conveyor. The elevator raises or lowers the car body, and powered rolls move the body to or from the elevator.

An unusual conveyor in the pre-delivery preparation area permits the side transfer of an automobile on wheels through a paint touch-up section. The car is moved by a single-strand pallet-top conveyor to the end of the conveyor, where it trips a limit switch. This actuates a double-strand transfer conveyor, with 21 in by 30 in flat-top pallets with lugs, which carries the car sideways to a third conveyor which travels in the opposite direction from the first.

Small buildings provide safe storage outside the plant for oxygen, acetylene and paint. Oil and petrol are stored in underground tanks. Underground safety tunnels lead from the centre of the plant to the outside parking areas for employee emergency exit. Other specific advances include the use of up-to-date racks, mobile rolling equipment and power equipment to accomplish the efficient mass movement of materials into and out of storage.

Assignment of stock areas and the width of aisles, which were part of a carefully developed materials-handling plan, took into consideration the requirements at each work location on the production line, as well as reserve stock space, and room for transporting and handling. Chain serves as the conveying medium for 122 of the floor conveyors. A total of 67,000 ft (12½ miles) of chain is employed, weighing about 500 tons. The principal types of conveyors used are dual chain, dual chain with rollers, dual chain side transfer, slat, flat top, and drag chain. Eight types of bushed roller chain and two types of rivetless chain are used for the

Car body and chassis finally come together on the dual chain conveyor final assembly line. After the Mercury body is properly mounted in position and bolted to the frame, the front-end assembly is received, and then the wheels and other components. From this assembly line the car is driven off to the test track



Cars get their final inspection while illuminated by banks of fluorescent lights. The conveyor shown is 450 ft long and consists of a single strand of flat-top chain, with special attachments spaced at intervals of 22 ft

conveyors. Some are fitted with special attachments and fixtures for carrying a particular part.

In addition to the 122 chain conveyors there are 26 powered roll conveyors and two belt conveyors. There are also 98 hydraulic live roll and lift tables, six gravity roll and lift tables, 15 transfer tables, five holding tables, six turntables, a track-mounted transfer car, and over 2,000 ft of gravity rolls. Since the conveyors are part of the assembly operations, the majority are required to run at variable speeds and are equipped with electronic speed controls. Some of the conveyors, specifically those used in the final assembly, have spare drives connectible by jaw clutches.

Securing Taper Joints

KEYED taper joints are commonly used for the mounting of such components as flywheels, gears, or grinding wheels on rotating shafts or spindles. The object of the taper is to ensure accurate centering of the component concerned and to transmit the drive. Normally, the key functions merely as a safeguard against slipping rather than as a driving member. Because of its shape, however, a keyed joint has several disadvantages. It is inherently out of balance, it requires a high degree of precision in manufacture, and it is likely to create difficulty in keeping the tapered centering surfaces clean.

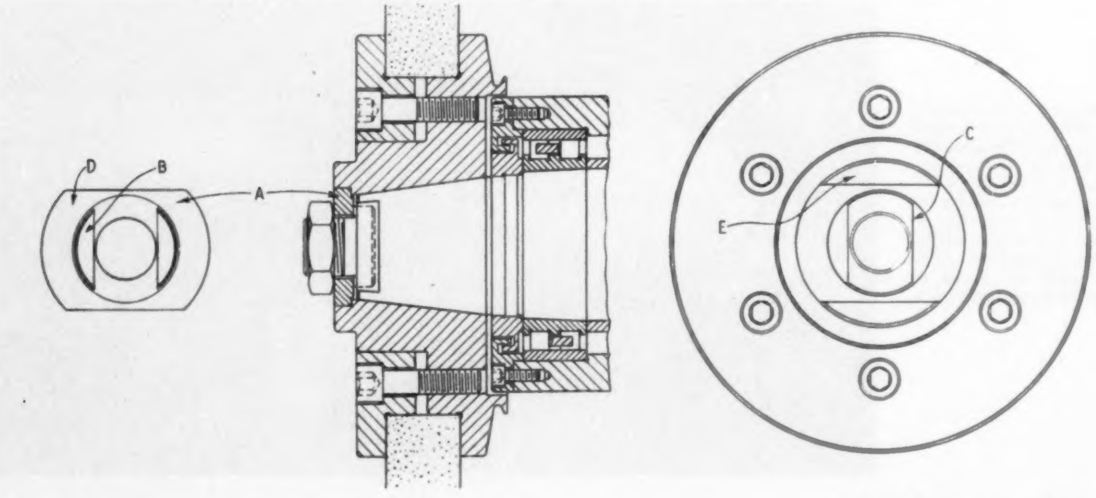
With the aim of eliminating these drawbacks, the Skefko Ball Bearing Co. Ltd. of Luton, Bedfordshire, has designed and developed a new method of locking components, or their hubs, on tapered shafts. In the illustration the mounting and locking of a grinding wheel on a machine spindle is shown as a typical example of the method.

The device consists of a coupling washer A having two projecting segments B which are engaged over flats C machined on the small end of the spindle taper. At right angles to the segments B the coupling washer is formed with two parallel flats D. These flats fit between projecting segments E on the grinding wheel hub, and the assembly is locked up by a nut on the screwed end of the spindle.

As the design is symmetrical, out-of-balance effects are obviated. The angular relationship of the coupling surfaces is similar to that of an Oldham coupling and the washer is self-aligning. Consequently, there is no need for extreme precision in manufacture. The smooth surfaces of the coupling elements can easily be kept clean. By reason of its simple design, the joint is inexpensive to produce and is readily adaptable for use in a variety of applications.

The Skefko method of locking taper joints

A coupling washer; B coupling segments; C flats on taper spindle; D flats on coupling washer; E hub or boss segments



Recent Publications

Brief Reviews of Current Technical Books

Engineering Precision Measurements

By A. W. Judge, A.R.C.Sc., D.I.C., Wh.Sc., A.M.I.Mech.E., M.S.A.E.

London: CHAPMAN AND HALL LTD., 37, Essex Street, W.C.2. 1957. 8¾ × 5½. 447 pp. Price 65s.

In this third edition of "Engineering Precision Measurements", there are four new chapters, which cover slip gauges, straightness and flatness measurements, interferometric methods, and surface finish. Many of the sections have been enlarged to include new practices, and an account of automatic gauging and work sizing has been included. This latter section undoubtedly is of special interest in view of the recent advances in the field of automation.

In general, the aim has been at giving a survey of the methods, machines and instruments involved in making the various engineering measurements coming within its scope. The chapters are headed as follows: Linear measurement, instruments and indicators; Micrometers, Verniers and measuring machines; Engineering fits, gauges and methods; Slip gauges and their uses; Screw thread measurements; Internal measurements; The measurement of angles; Comparators; Other optical measurement methods; Measurements of straightness, flatness and alignment; Interferometry methods; Miscellaneous methods and appliances; Surface finish; and Automatic gauging and work sizing.

The Motor Industry

By George Maxcy and Aubrey Silberston.

London: GEORGE ALLEN AND UNWIN LTD., Ruskin House, 40 Museum Street, W.C.1. 1958. 8¾×5½. 245 pp. Price 25s.

Although motor manufacture is one of the most important of British industries, relatively few serious economic studies have yet been written about it. The object of the book under review is to give a comprehensive survey of the industry as seen by the economist. At the same time, an attempt is made to fill in some of the more obvious gaps in the information currently available, particularly as regards the effect of large scale production on cost of manufacture. Although the book is devoted mainly to the British motor industry, many references are made to the motor industries of the United States and other leading motor manufacturing countries.

Among the subjects discussed are: the structure of the British motor industry; the demand for vehicles; technique of production; the structure of costs; economies of large scale production; competition in the car market, 1929-1956; the nature of competition in the industry; profits and sources of funds; future prospects; and the final chapter is headed Conclusions. There are four appendices: the first is entitled, The capital-output ratio in the motor industry; the second is, Comparative productivity and prices in the British and American motor industries; the third is, The relative prices of British and Continental cars; and the fourth appendix comprises Statistical Tables.

The Practical Engineer Pocket Book

Edited by N. P. W. Moore, B.Sc., A.C.G.I., D.I.C., A.M.Inst.F., A.M.Inst.P.

London: SIR ISAAC PITMAN AND SONS LTD., Pitman House, Kingsway, W.C.2. 1958. 5¾ × 3¾. 744 pp. Price. 12s 6d.

In the new edition of this book, two sections have been drastically revised, and the opportunity has been taken to modify several others to bring them up-to-date. The section on metallurgy has been largely rewritten, and the subjects of creep and fatigue, which are of growing importance to the mechanical engineer, have been briefly introduced. In the section dealing with the thermodynamic properties of steam, the material has been extensively recast and new tables on steam properties introduced. The values shown in the tables have been abstracted from the well known work of Keenan and Keyes, which is now universally accepted as the best data for engineering calculations commonly required in this sphere.

The list of chapter headings is as follows: General information; Pipes, beams, columns, springs, etc.; Bearings and mechanical transmission; Cranes and lifting tackle; Pyrometry; Metallurgy; Steam; Steam generation; The steam engine; Locomotive practice; Steam turbines; Condensers; Gas and oil engines; Gas turbines; Air compressors; Air and ventilation; Hydraulics; Machining of materials; Modern lubrication; Welding and cutting; Industrial hygiene; and Unified screw threads. Technical dictionaries, from German, French and Spanish into English, are also included.

Ball and Roller Bearings

By Eschmann, Hasbargen and Weigand.

London: K. G. HEYDEN AND CO. LTD., 52 Cranbourne Gardens, N.W.11. 1958. 9½×6½. 375 pp. Price 56s.

Technological progress is exacting increasing demands in all fields of design and manufacture and, consequently, on the design and application of ball and roller bearings. The solution of these diverse bearing problems requires, among other things, a detailed knowledge of anti-friction bearing technology on the part of the design engineer. This book has been compiled to serve as a guide in the logical application of such knowledge.

Types, materials, dimensions and tolerances of the most important bearings currently manufactured are discussed. The theoretical section of the book is arranged in such a way that a consideration of bearing stress and kinematic phenomena precedes a discussion of the basic relationships of carrying capacity, loading and life expectancy. The limits beyond which calculated solutions cease to be meaningful in practice, are also indicated. After the section on the fundamental consideration of bearings prior to installation, the task that the bearings must fulfil in actual service is investigated. This task presents a series of individual problems the solutions of which are illustrated by design principles and their practical realization. In the final section, typical examples are selected from the vast field of bearing applications to illustrate upon which bases the optimum solution of a bearing problem may be attained. This enables the designer to determine bearing arrangements for special cases that are not discussed in the book.

This book is based on the work entitled "Die Wälzlagerpraxis," so the ball and roller bearing designs, specifications and standards discussed in it are those used in Germany. The essential data concerning the German practice are contained in tables, and two supplements are supplied separately with the book, one containing conversion tables and the other containing load ratings of ball and roller bearings.

There are six sections in the book. The first is headed, Types of ball and roller bearings; the next one is entitled, Bearing calculations; and it is followed by, Basic principles for the design of bearing arrangements. The last three are: Design of bearing locations; Bearing failures; and Examples for the calculation and design of ball and roller bearing arrangements.

Automobile Electrical Maintenance

By A. W. Judge, A.R.C.Sc., D.I.C., Wh.Sc., A.M.I.Mech.E., M.S.A.E.

London: SIR ISAAC PITMAN AND SONS LTD., Pitman House, Parker Street, Kingsway, W.C.2. 1958. 7½×5. 272 pp. Price 15s. 6d.

The fourth edition of this well-known book has recently been published. Additional material has been added in the form of a new chapter at the end. In this chapter, the original plan for presentation of the information in a simple and compact manner has been followed.

The new material includes information on direction indicator flasher systems; the Lucas model RB106/1 and 106/2 control boxes and their circuit fuses; current and voltage control regulator units, including the Auto-Lite current-voltage regulator; automobile cable connectors and some ignition timing notes relative to the employment of high octane fuels for automobile engines.

Who's Who in the Motor Industry

London: TEMPLE PRESS LTD., Bowling Green Lane, E.C.1. 1958. 8¾×5½. 522 pp. Price 42s.

The third and completely revised edition of "Who's Who in the Motor Industry" is both a guide to the structure of the British car and commercial vehicle industries and a unique directory of people, not only in those industries and their allied distributive trades, but also in the wider spheres of the associations, organizations, learned bodies and motoring clubs, which together constitute the world of British motoring.

In the motor industry section, which occupies the larger part of the book, there is a complete list of all British manufacturers of cars and commercial vehicles, with the names of their directorates and chief executives. This is followed by similar lists of engine builders, body builders, coachwork specialists, caravan and trailer manufacturers and makers of industrial truck and mechanical handling equipment.

Approximately 100 pages are devoted to the industry's suppliers of equipment and services, including manufacturers of accessories and components, and the petrol, oil and tyre companies, as well as finance houses, industrial bankers and car delivery companies. This section contains over 1,300 entries. There is also a list of about 1,900 distributors and main dealers, many with the names of their directors and senior personnel.

In the organizations and associations section are details of government bodies and the many professional, industrial and trade associations concerned with the automotive industry and road transport. This section also contains the names of the principal officials and members of councils or committees. Motor sport is represented by comprehensive lists of motorists' associations and motor clubs, including all motor clubs in affiliation with the R.A.C., and the secretaries' names and addresses are given.

The press guide lists all the motoring and road transport journals published in this country. It also gives the directorates of the public companies, and the holders of editorial and other appointments on the journals. Also included in this section is a list of motoring correspondents of the national and provincial press, and the membership roll of the Guild of Motoring Writers. Finally, in the biographical section, there are personal details of nearly 1,250 individuals distinguished by the prominent part that they play in the industry or in other spheres associated with British motoring.

A Handbook on Torsional Vibration

By E. J. Nestorides.

London: CAMBRIDGE UNIVERSITY PRESS, Bentley House, 200 Euston Road, N.W.1. 1958. 9¼×6. 664 pp. Price 110s.

Because of the trend towards higher power output, increased running speeds and the maximum utilization of engineering materials, designers now have to consider in great detail the torsional vibration conditions of engines and the machines they drive. Rule-of-thumb formulae are being replaced by more accurate data obtained from recent research.

Work in the BICERA laboratories and the accumulated experience of member firms of the association are used in this handbook as the basis for an engineering approach to the various problems associated with torsional vibration. It gives much new information, including exact formulae, design procedures, specifications, and methods. One of the features of the book is the method of crankshaft stiffness evaluation developed largely as a result of work undertaken by BICERA. This method takes into account various details of different crankweb designs.

A useful feature of the book is that in addition to giving formulae and graphical procedures, together with numerical graphs and tabulated values, it also comments on the limitations of each method and its mathematical derivation. For the development engineer, descriptions of experimental procedures, rigs and instrumentation are given in detail. Also, precautions against possible sources of error are discussed and some notes are given on the order of accuracy to be expected of the test results. An endeavour has been made to present the definitions and derivations with a reasonable minimum of mathematics, and illustrations have been used to facilitate the explanation where necessary. Many subjects are treated more extensively than hitherto, and indications are given of the directions in which further research is required. The various sections also include discussions on problems associated with torsional vibration in its widest possible sense, and give at least an outline of the methods required in dealing with matters at present of secondary importance but which may become prominent in the future.

The book is divided into four parts. Its first part is entitled, Preliminary calculations and measurements, and is sub-divided to deal with Moments of inertia, Stiffness, and Natural frequency calculation. Part 2 deals with Evaluation and prediction of torsional vibration stresses. Its sub-divisions are: Tangential-pressure components due to gas pressure and inertia; Phase-angle diagrams and phase-vector sums; Evaluation of stresses from vibration measurements; Prediction of vibration amplitudes and stresses; Recommendations, rules and guidance notes of classification societies regarding permissible torsional vibration stresses; and Cyclic speed variation. The third part deals with Design and operation of various devices for limiting vibration. The sub-divisions are: The tuning disc without damping; The tuning disc with damping; The untuned viscous-shear damper; Slipping-torque type dampers; Pendulum detuners; and Further types of dampers and detuners. Part 4 is on Instrumentation, and it is dealt with under two sub-headings as follows: Equipment for the measurement of torsional vibration amplitudes; and Equipment for the measurement of vibratory strains.

Vehicle Headlamp Testing

By V. J. Jehu, M.Sc., A.Inst.P.

London: HER MAJESTY'S STATIONERY OFFICE, York House, Kingsway, W.C.2. 1958. 8×6½. 8 pp. Price 2s.

This is Road Note number 23, issued by the Road Research Laboratory of the DSIR. It describes the various types of headlamps and auxiliary lamps currently in use and outlines suitable procedures for finding and correcting faults. The work also describes types of beam testing equipment now available. It is divided into sections as follows: Introduction; Headlamp systems; Auxiliary lamps; Test procedure; Aim of headlamps and auxiliary lamps. Finally, there is an appendix describing beam testing equipment.

FBI Register of British Manufacturers—1959

London: KELLY'S DIRECTORIES LTD. and ILIFFE AND SONS LTD., Dorset House, Stamford Street, S.E.1. 1958. 9½×7¼. 1,140 pp. Price 42s.

The FBI Register, a comprehensive and accurate guide to a substantial cross section of British Industry, includes lists of the products and services of over 7,500 member firms under more than 5,400 alphabetical headings. It contains, in addition to a Classified Buyers' Guide, seven other sections, giving addresses of companies and firms, and valuable information about trade associations, proprietary names, trade marks, etc. A feature providing a useful reference for buyers not fully conversant with British product terms, is the section containing the French, German and Spanish glossaries. These glossaries give translations of every product term used in the main buyers' guide, each being numbered for easy cross-reference between the English headings and their translations.

As the only authorized directory of the Federation of British Industries, the FBI Register is compiled by the publishers in close collaboration with the Federation. It is undoubtedly of considerable use to importers, buyers, Trade Commissioners, Chambers of Commerce, Commercial Attachés, Reference Libraries and Departments of Trade and Industry throughout the world.

The contents are as follows: Foreword by the President of the FBI, Sir Hugh Beaver, K.B.E.; Details of the organization, Aims and activities of the FBI at home and overseas; French, German and Spanish sections; Products and services; Classified buyers' guide; Language glossaries; Addresses; Alphabetical directory; Trade associations; Brands and trade names; Trade marks.

Welding Handbook

By Arthur L. Phillips.

London: CLEAVER-HUME PRESS LTD., 31 Wright's Lane, Kensington, W.8. 1958. 9¼×6. 564 pp. Price 72s.

For many years this handbook of the American Welding Society has been well-known as one of the leading reference books in its field. The work under review is Book I of the completely recast fourth edition. The complete set will comprise five independent books and will be published approximately one each year. Book I covers basic principles and data. The essential information is given, and further details can be obtained from many of the original sources of information listed in the bibliographies at the end of the chapters. This work is the outcome of combined efforts of many leading experts in industry, education, research and other branches of welding practice. It is intended to serve both as a reference work and as a textbook. The chapters are headed as follows: Standard welding terms; General engineering tables; Fundamentals of welding metallurgy; Properties of welded joints; Thermal and mechanical treatment of weldments; Design of welded joints; Factors and data involved in estimating costs; Inspection of welding; Standard methods for mechanical testing of welds; Statistical control of weld quality; Safe practices in welding and cutting. The work concludes with an alphabetical index.

REINFORCED PLASTICS ROOFS

A Survey of Recent Developments and Future Trends in Van Bodywork Roof Design and Construction

DURING the last six years, the number of van bodies with translucent roofs in one form or another has increased rapidly. The problem that has confronted body designers and builders is to obtain as much natural light as possible inside an enclosed body without incurring the disadvantage of the entry of rain or melting snow through the joints. A number of methods based on the introduction of some form of glass light let into the roof panels has been tried, but none of these was ever widely adopted, mainly because of water seepage through the joints of glass, frame and panel. The difficulty of finding a satisfactory seal, which will remain watertight under service conditions, arises because the roof area is subjected to a series of twisting strains that loosen the joints locally.

It became apparent that the practical requirement is for a material that is by nature both flexible and translucent; these two features are characteristics of synthetic resins and glass fibres, and the adoption of a combination of polyester resin and glass has led to a considerable forward step in roof development. With this material, a large area can be moulded in one piece to a pre-determined shape. The resin can, of course, be set by the introduction of chemical agents, or catalysts, and the action normally proceeds at room temperatures. Most of the strength of such a moulding is derived from the glass fibre laminations.

During the early stage of development, it was natural to try using a standard metal roof, suitably cleaned and polished, in or on which to lay-up the resin and fibre, to produce a similarly shaped moulding in one piece and reasonably translucent. However, the main problem was that the roof moulding made directly from an existing metal roof was either too large or too small, according to which side was used. The next step, clearly, was to make a separate mould to produce components of the correct dimensions.

By 1954, the interest of many bodybuilders in Britain had been awakened to the extent that they started experimental work with the new material, generally in their paint shops because this part of the factory was kept at a constant temperature. At the same time, a number of firms set up as reinforced plastics fabricators bent on supplying bodybuilders with mouldings made by the hand lay-up, cold moulding process. It is of interest to note that few of these fabricators are still in business.

In 1955, the bodybuilders concentrated on producing roof mouldings to suit their existing vehicle designs, which in many cases embodied radiused corner domes, sides and ends. Roofs of this pattern were costly to produce by hand in other materials, so a moulding appeared to be the answer. However, it was soon realized that there were a number of difficulties. Manufacturers who made up large one-piece moulds suitable for one roof size were faced with the problem of finding storage space for those moulds when not in use. In addition, they had the prospect of having to make a new mould for each different size of roof required, and investigation proved that in many instances this would be economically unsound. On the other hand, if they were able to persuade one of the fabricating firms to make roof mouldings to the dimensions required, the cost of transportation often proved excessive and, because of their shape, these large mouldings often arrived in a damaged condition.

The next stage of development was a change in the method of producing the moulding, without modifying the shape, namely, the introduction of roof joints, which were

An example of the first stage in the development directed towards a complete translucent roof. In this instance the roof is in the form of a one-piece glass fibre reinforced plastics moulding supported on the normal roof framing. Each roof stick is fitted with a length of rubber strip on top, for the moulding to rest on, and the translucent panel is secured along each side and to the front and rear boards of the van body

The second stage of development of a translucent reinforced plastics roof for a van. In this example, a series of prefabricated roof stick mouldings have been laid up during the preparation of the main moulding. On assembly to the van, the ends of each roof stick rest on and are located by the metal or timber cant rails on the main framework of the body of the van but are not attached to them in any way

the subject of much controversy. The main argument against such joints was that water would seep through them. This argument, however, proved to be invalid for two reasons. The first was that the joints, as well as the rest of the roof panel, were flexible and therefore capable of movement when the body distorted. Secondly, the material used for making the joints was identical with that of the mouldings.

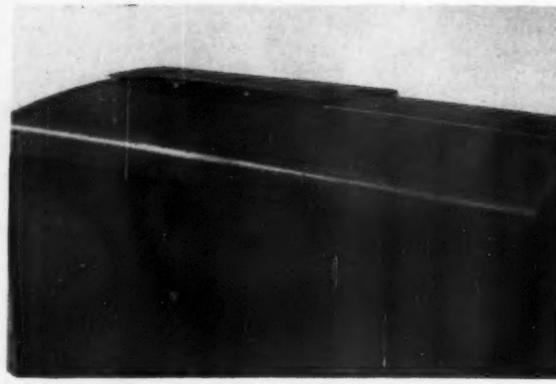
In one instance, the roof was built up from several panels with transverse joints between them. This meant that a much smaller mould could be used. The mould was, in fact, the first few feet of the roof, incorporating the radius on each side and at one end; the other end was left open. The front and rear sections of the roof were laid up using the complete area of the mould, whereas the intermediate mouldings were made in only part of the mould, the radiused end not being used. With this method of production, any length of roof can be produced for bodies of a given width. Moreover, crating and transport costs can be greatly reduced.

Since mouldings with radiused ends and incorporating corner domes are expensive, there was a trend towards the use of flat roof-ends. This design enabled the roof mouldings to be simplified, because each end of the moulding was open to fit over the end boards. Even so, the side radius was still a variable factor, ranging from 2 in to 10 in according to the whim of the bodybuilder or his customer.

While this evolution in roof design was taking place, many bodybuilders, after holding back to see how the projects developed, obtained flat sheets of the plastics material and inserted these into their otherwise standard roofs. This application was far more successful than had been the earlier glass lights. Much of the success was due to the fact that the material in sheet form was sufficiently flexible to distort readily with the body upper structure. Usually a large area was inserted, about 6 ft$\times$3 ft, and this allowed flexible sealing strip to be used for the water-proof joints.

However, during the period 1954 to 1956 not all roof designs or mouldings were satisfactory, and in 1956 the author carried out a detailed investigation on three types of reinforced plastics roof mouldings supplied for a large fleet of vans. The aim was at studying the design and service life of the translucent reinforced plastics roofs, with a view to indicating the reasons for breakdowns of some different types under service conditions. Four of each design were mounted on twelve vans operating within a certain locality, and these were kept under regular observation. The actual mouldings were:

1. A single translucent sheet, radiused at the sides. It was dropped on to a conventional aluminium framing and supported by a number of roof sticks, but not attached to them. This assembly was secured at the front and rear, and along both cant rails. It overlapped the tops of the side panels and the edges were covered with a drip moulding.
2. A moulding with corner domes and curved sides and ends; in addition, a series of reinforced plastics roof sticks were introduced into the wet lay-up and thus bonded to the main moulding. These sticks rested on the framing cant rail but were not attached to it. The whole one-piece unit was secured to the front, rear and sides of the van framing.
3. Similar to 2, but with a series of aluminium roof sticks built at 2 ft intervals into the moulding. The ends of these sticks were bolted to the cant rail in the normal manner. In this case, the fixings for the roof moulding were at the ends of each stick, along both sides and at the front and rear ends.



The latest development is the provision of a kit of parts for the roof; one section of the roof moulding can be seen lifted at the far left-hand corner. All the sections are joined together with material provided in the kit; the joints of the four sections can be seen in this illustration

A later stage in the development of plastics roofs was the provision of a large translucent panel moulded to a metal frame, which could be riveted to the edges of a hole in the metal roof

The period of observation included that of the heavy snowfall of the winter of 1956, followed by a very wet period, and the results obtained with the twelve mouldings were tabulated. These observations proved without any doubt that the roof mouldings that were free to distort with the body were satisfactory, while those that were tied down were not. The failures were due to the resin cracking up and breaking away, in some cases leaving glass fibres exposed, with detrimental effects in wet weather.

Observations were made about the actual production of the mouldings, and its relationship to the subsequent service life. Troubles arose from manufacturing features such as too small a ratio of resin to glass, and the quantity of glass used being insufficient to ensure retention of the moulded shape. They indicated that the quality of a roof moulding has a direct bearing on its service life. One result of this report is that most van roof mouldings are now secured flexibly to their framing. Normally, the minimum space between fixings is 4 ft, and this has proved to be satisfactory during the past two years.

By 1957 most of the problems with regard to the material and its application had been solved, and so development work proceeded along the lines of greater output and standardization of roof design. Mouldings are also used extensively in conjunction with sets of aluminium sections, including radiused roof sticks, supplied by various wholesale houses. Translucent reinforced plastics mouldings, 4 ft long, with curved sides to fit the roof sticks, are supplied; the number of lengths needed is dependent, of course, upon the length of the body to be built. Adjustment for different requirements in respect of width can be accomplished in

several ways. One is to use sheets of reinforced plastics material, about 4 ft wide, longitudinally along the centre of the roof and to use metal for the two side areas, the adjustment for width being made on the metal sections. This method is adopted generally on large Luton type vans, built for the transportation of a specific load for which a reasonable amount of interior light is required but not so much as is desirable for a parcels van, in which the driver may have to read names and addresses on the goods.

There are many instances, particularly in specialist bodywork, where it is not desirable for the whole of the roof moulding to be translucent. Accordingly, considerable work is now being carried out to provide complete mouldings that are filled and colour pigmented except in those areas where translucency is required. There are also projects, such as that of Ridgeway Plastics Ltd., of 242 Romford Road, Forest Gate, London, E.7, for the supply of complete kits of mouldings which, when assembled, form a translucent roof for vans of any width or length. The kits that this manufacturer intends to supply each comprise moulded sections 12 ft long and 4 ft wide. Two sections are supplied for a van body 12 ft long, the joint being made along the centre of the roof. Supplied with the sections is a box containing the resin and glass fibre to make the bond between the sections, and a pamphlet giving step-by-step instructions. The first kits will be available with sections of one of two shapes, either with an edge radius of $3\frac{1}{2}$ in, or with a razor-edge corner. No radiused end portion or corner domes are included. If the price of such standard kits makes them an economic proposition it is possible that there will be a minor revolution in van roof design by the time of the next Commercial Vehicle Show.

Commercial Vehicle Heater

A NEW and low priced cab heater for commercial vehicles has been announced by the Clayton Dewandre Co. Ltd., Titanic Works, Lincoln. This new heater is designated the D.9 unit, and its overall dimensions are $8\frac{1}{2} \times 7\frac{5}{8} \times 7\frac{1}{2}$ in. Because of its compactness, the unit can be installed without difficulty in the majority of cabs. Preferably, it should be mounted beneath the windscreen, and connected to a fresh air inlet, but it can equally well be used as a recirculator. Ventilation in warm weather can be provided by operating the unit with the hot water turned off.

A feature of the D.9 heater is the four removable and interchangeable outlet panels, which enable the operator to vary the layout to suit the particular requirements. The cab heating is controlled by a flap on one of the panels, whereas the other three can be supplied either in the form of blanks or with one or two demister outlets. With a temperature difference of 120 deg F between the cooling water and ambient temperatures, the output of the heater is 9,000 B.Th.U./hr, which is equivalent to $2\frac{5}{8}$ kW. If the temperature difference is 150 deg F the output is 11,250 B.Th.U./hr, or $3\frac{1}{4}$ kW. The rate of air flow through the fan is 105 ft^3/min.

The new Clayton-Dewandre D.9 heater is compact and therefore can be installed without difficulty in the majority of modern cabs

Synthetic Rubber

POLYURETHANE rubber is coming into increasing use in the automobile industry because of its good physical properties, not the least of which is its resistance to lubricating oils and hydraulic fluids. It has a high mechanical strength and great resistance to abrasion, and can readily be machined. One variety of this material, known as Prescollan, a product of Precision Rubbers Limited of Bagworth, Leicester, was introduced in 1955. The technique employed in its processing has recently been improved, with the result that its range of applications has been considerably increased. Among those uses for which it is now suitable are O-rings and other seals for hydraulic and pneumatic systems; bearing pads for unlubricated ball joints, such as are employed in steering systems; bearing bushes for steering columns; and protective gaiters for various purposes.

Suspension Testing

AT THE recent Electronic Computer Exhibition at Olympia, a novel use of electronic equipment was demonstrated on the stand of E.M.I. Electronics Ltd. One of the company's EMIAC II computers was adapted as a wheel suspension simulator. It was used in conjunction with a model car of one-quarter scale, for the investigation of wheel suspension behaviour. By means of a rotating drum, a representation of either of two M.I.R.A. test surfaces was applied to one front wheel of the model; one was the *pavé* and the other the corrugated track. Electrical impulses corresponding to the track surface and wheel behaviour were fed into the computer, and the oscilloscope traces indicated the performance of the suspension system employed. By making adjustments and observing the results, it was thus possible to obtain the optimum ride.

E.M.I. Electronics Ltd. have pointed out that the equipment described was purely for demonstration purposes. However, they suggest that this application of an electronic computer is worthy of consideration by vehicle manufacturers. Since it would permit at least the initial stages of suspension testing to be carried out in the laboratory, it should reduce the amount of track testing necessary, and thereby save time and labour.

Die Casting

FOR THOSE interested in zinc alloy die castings, a news bulletin entitled *Die Casting News* has been introduced by the Zinc Alloy Die Casters Association, an affiliated member of the Zinc Development Association. The first issue is attractively laid out and contains a number of reproductions of photographs, and also details of current applications of castings of this type. The items chosen illustrate the various advantages of the process, such as good finish, the ability to produce complex shapes, and the minimizing of machining time. Among the automobile applications referred to are carburettor bodies, headlamp cowls and styling motifs.

Copies of *Die Casting News*, which will be published three times per year, are obtainable on request from the Zinc Development Association, 34 Berkeley Square, London.

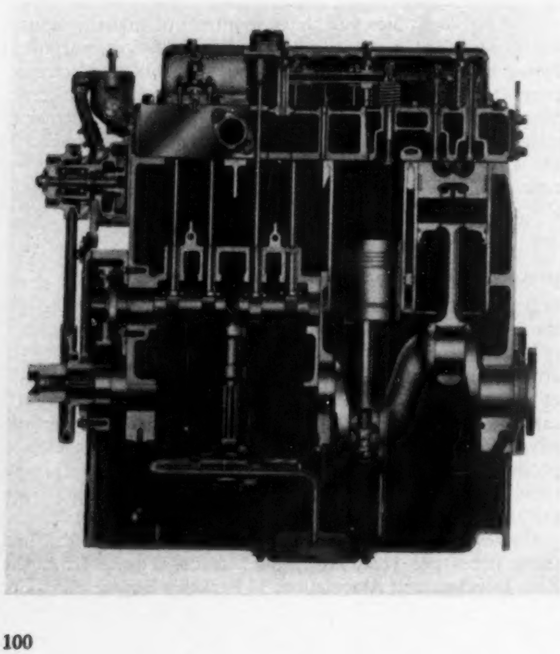
NEW PERKINS ENGINE

Four-Cylinder Multi-Purpose 4·42 Litre

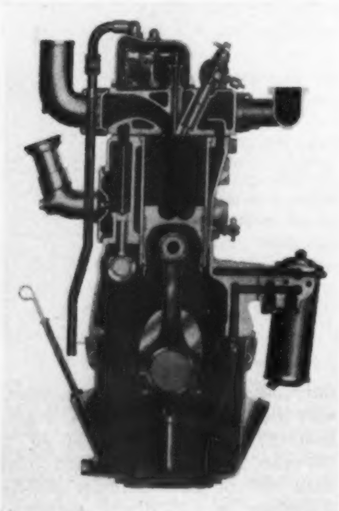
Diesel Unit with Direct Injection

The new Perkins Four 270D engine is of orthodox and robust design

A NOTEWORTHY addition to the range of diesel engines made by F. Perkins Ltd., of Peterborough, is the four-cylinder 4·42 litre Four 270D unit. In effect a development from the familiar L4 engine, it is intended for similar duties, namely tractors, combine harvesters and industrial and marine applications. Undoubtedly the most interesting feature of the new engine is the direct injection system. Hitherto the company has been faithful to the swirl chamber layout, with which it has achieved very good results, so the Four 270D unit represents something of a milestone in Perkins history. A major changeover to direct injection is not foreshadowed by its introduction, but the makers consider that, for the speed and the type of duty concerned, the system has certain manufacturing and operational advantages. Exceptionally low fuel consumption and easy cold starting are claimed for the engine.



As on the L4 engine, the bore is 108 mm (4·25 in) and the stroke 120·6 mm (4·75 in). A single iron casting forms the crankcase and cylinder block, and wet cylinder liners are fitted. The joint face for the sump is on the horizontal plane through the crankshaft axis. Thin-wall bearings with a copper-lead lining are employed for the three main bearings and the big-end bearings, so the crankshaft journals are induction hardened. Location of the big-end caps is by serrations on their two abutting faces. A spiral gear on the camshaft, between numbers 1 and 2 cylinders, drives the gear type oil pump. Both the camshaft and the C.A.V. DPA fuel pump gears are driven by a spur gear on the forward end of the crankshaft. The fuel pump governor is of the mechanical type, and slotted holes in the driving gear are provided to allow for adjustment of the pump timing.



Direct injection is used in conjunction with offset, toroidal combustion chambers. There is no masking of valves or ports

Formed in the piston crowns, the open combustion chambers are of toroidal shape, the axis of the toroid being slightly offset from that of the piston. Fully floating gudgeon pins are employed and each piston carries five rings: above the gudgeon pin are three compression rings and a scraper ring, while there is another scraper ring below the pin. Except in the case of the unit for combine harvesters, the top compression ring is chromium plated.

The camshaft actuates flat-base tappets and orthodox push rods and rockers; duplex valve springs are employed on the vertical valves. The four-hole injectors are inclined and offset in the cylinder head, and the individual sprays are so arranged as to ensure maximum utilization of the air. Valve

or port masking is not employed to govern the air swirl in the cylinders. Instead, the speed and direction of the incoming air are controlled by the design of the inlet ports.

Fuel is lifted to the DPA pump by a diaphragm type pump, mounted on the top of the timing case and actuated by a push rod and an eccentric on the hub of the fuel pump gear carrier. Provision is made on the cylinder head for the fitting of a paper element fuel filter. Except on the marine version, the cooling system embodies a thermostat, and the centrifugal water pump is belt driven from the crankshaft. A fan can be mounted on the pump pulley if desired. In the marine form of the engine, the pump is gear driven from the timing train, and a thermostat can be fitted where necessary.

The 12 volt generator is driven by the same belt as the water pump, and there is accommodation at the rear of the unit for a normal starter motor. A Thermostart heater is fitted in the air intake manifold. Provision is made for the mounting of decompressor gear, to permit hand starting. A power take-off from the camshaft gear can also be fitted. Maximum continuous torque from the power take-off is 35 lb-ft, but an intermittent torque of 40 lb-ft is permissible.

Exclusive of air cleaner, flywheel, starter motor and ring gear or flywheel housing, the tractor version of the engine weighs 680 lb dry. The industrial unit similarly weighs 722 lb; weights for typical tractor and industrial flywheels and starter rings are respectively 105 and 176 lb. In its marine form, complete with direct-drive gearbox and accessories, including starter motor, the unit has a weight of 1,170 lb.

At the maximum governed speed of 2,000 r.p.m., the tractor engine develops 62 b.h.p. gross, and its maximum torque of 189 lb-ft is produced at 1,000 r.p.m. The industrial engine has a gross output ranging from 32·6 b.h.p. at 1,000 r.p.m., with 172 lb-ft torque, to 56·5 b.h.p. at 2,000 r.p.m., at which speed the torque has fallen to 148 lb-ft. Again at 2,000 r.p.m., the power of the marine engine, measured at the output flange of the direct-drive gearbox, is 58 b.h.p.

New British Cars

SUMMARY OF THE NOTEWORTHY FEATURES OF RECENTLY INTRODUCED VEHICLES

M.G. Magnette Mk III

THE post-war M.G. Magnette, though bearing no resemblance to earlier models of that name, carried on the company's traditions of lively performance and good handling. This successful model is now superseded by the Magnette Mk III, which was announced early in February and which should provide much the same characteristics as its predecessor. Although the Mk III version still has the 1,489 cm^3 B.M.C. Series B four-cylinder engine, with minor modifications, it is in no way a derivative of the earlier car. Styled by Pinin Farina, the unitary body-chassis structure is completely new and provides considerably more accommodation for passengers and luggage than did the Z models. The range of vision is also improved by virtue of increased window area.

Of orthodox design, the unitary structure has 20 S.W.G. steel outer panels and floor. The side members extend the full length of the vehicle and the flooring is extensively ribbed for added stiffness. Although the overall length and width of the Mk III model are greater by 9⅛ in and 2½ in respectively than the corresponding dimensions of the Z series, the wheelbase is 2$\frac{13}{16}$ in less, being 8 ft 3$\frac{3}{16}$ in; the front track is 2⅛ in less and the rear track 1⅛ in less. The earlier vehicle had equal front and rear tracks of 4 ft 3 in. It follows that the overhang all round is greater, and the increased dimensions have resulted in a slight increase in weight, from 21¾ cwt to 22¼ cwt.

The body styling conforms with the modern trend. It features a falling bonnet line, between slightly peaked front mudguards, and not very pronounced tail fins, which extend half way along the rear doors. Increased door width is a notable feature of the new body and it is matched by greater interior width, particularly at the rear, where the cushion width and elbow room have both been enlarged by 4½ in. Even more marked is the increase in boot capacity from 12 to 19 ft^3; the boot lid is counterbalanced by torsion bars to avoid the use of a stay. The spare wheel is carried below the floor of the boot. A noteworthy feature of this car is that the heater and windscreen washers are standard equipment.

All the interior finish is of a high quality, with leather

The new M.G. Magnette Mk III has trim lines, though the rear overhang is pronounced. Both the bumpers are of the wrap-round type, as are the windscreen and rear window

upholstery and a walnut veneered facia. The windscreen and rear window are of the wrap-round type, as are the bumpers, which have shallow over-riders. Polished stainless iron is employed for the waistline and the surrounds of the windscreen and windows. A welcome detail is the use of the so-called zero-torque door locks: not only do these locks permit the doors to be shut by finger pressure but they embody safety catches, operated before the doors are shut, which prevent accidental re-opening from the inside. Considerable attention has been paid to dust sealing and sound insulating of the body.

A conventional front suspension layout has been adopted. It embodies forged wishbones of unequal length, in conjunction with coil springs and lever type dampers to which the upper wishbones are attached. Carrying the complete front suspension assembly is a cross member on rubber mountings under the front of the body structure. The sensitive and accurate rack and pinion steering gear of the earlier Magnettes is replaced by a steering box of cam and peg pattern, operating through a three-piece track rod. This change has been made for two reasons: it has allowed the steering column to be raked at a more comfortable angle, and results in less road reaction at the steering wheel.

The live hypoid rear axle is carried on long semi-elliptic springs with rubber bushed shackles and lever type dampers. Because of the reduction in tyre size from 5·50-15 in to 5·90-14 in, the axle ratio has been raised from 4·55:1 to 4·30:1. With these smaller wheels, the brake drum diameter has been reduced from 10 in to 9 in, but the width of the front brake linings has gone up from 1¾ in—still employed at the rear—to 2¼ in. As a result, the total lining area is 147 in^2 as against the previous 134 in^2.

As before, twin S.U. carburettors are fitted to the Series B engine, but they are of the latest H.D.4 type, incorporating a separate slow-running system and improved sealing of the jet tube assembly. Modifications to the exhaust manifolding have resulted in greater freedom of gas flow, and hence a small improvement in the torque characteristics. To improve part-throttle fuel economy, the inlet manifold is now exhaust heated, a feature that accounts for the slight fall off in peak power. The maximum gross output is quoted as 66·5 b.h.p. at 5,200 r.p.m., as against 68 b.h.p. at 5,400 r.p.m. for the previous unit. A short, central lever operates the four-speed gear box, which has synchromesh on second, third and top, and provides internal ratios of 1:1, 1·37:1, 2·21:1 and 3·64:1, with a 4·76:1 reverse.

Vauxhall Victor Series 2

SINCE its introduction two years ago, the 1,507 cm^3 Vauxhall Victor has undergone a steady process of refinement. Although all the minor improvements evolved during that period are incorporated in the Series 2 model, announced towards the end of February, the most important changes are to the styling, which has been considerably enhanced. The main aim of the body modifications has been at attaining a better appearance by smoothing out the swagings and changes of section, which failed to meet with universal approval on the Series 1 cars. In addition, the front and rear aspects have benefited from a simplification of the decorative treatment.

The most noticeable alterations to the side elevation are the increased curvature at the front of the roof, and the reshaping of the rear door panel above the waistline, to eliminate the former swaging. A change has been made in the form of the rear wings to blend them into the bumper, which is now of wrap-round pattern and simpler design. The boot lid shape has been improved by the elimination of the depression round the lock. At the front, the radiator grille has been widened, and embodies the side and indicator flasher lamps at its extremities. The front bumper, too, has been simplified; its strength is increased, and the wrap-round extends to the wheel openings.

A new design of bench type front seat on the Standard and Super models provides greater comfort for its occupants and more foot room for the rear seat passengers. The newly introduced de Luxe Victor has separate front seats which, like the bench seat, are adjustable by means of spacers for height and angle. This model has upholstery in two-tone leather, but single-colour Vynide continues to be employed on the other models. Another refinement of the de Luxe Victor is the fitting of tread plates on the door sills. On the Estate Car, the latest version of which in general has been modified in the same manner as the saloons, luggage space and loading width have been increased. This has been done by repositioning the spare wheel, which is now mounted vertically against the right-hand side of the rear compartment.

The unitary chassis-body structure is unchanged from that of the later of the Series 1 models, except in respect of the styling details already mentioned. Among the modifications effected during the past two years are improvements to the body sealing, and stiffening of the front doors.

Styling changes effected in the development of the Vauxhall Victor Series 2 have noticeably improved the appearance of the vehicle. Few mechanical alterations have been found necessary

The locks are of the burst-proof type and the rear locks embody safety catches to prevent children from accidentally opening the doors. A practical point is the treatment of the undersurfaces of the body with a 0·1 in thick layer of bituminous compound, a feature likely to extend in popularity on quantity produced cars.

During the development period, changes have been made in the production of the gears for the three-speed gearbox, which has synchromesh on all forward gears. Rear axle noise has been reduced by a modification to the tooth form, and every axle is individually checked for correct pinion loading. No alterations have been required to the suspension, steering and braking systems. To minimize thermal distortion, brake drums of the two-piece type are used; their diameter is 8 in and the lining width is $1\frac{1}{4}$ in.

In the Victor, the engine has a stroke : bore ratio of 0·96 and develops 54·8 b.h.p. gross at 4,200 r.p.m. Its maximum torque of 84·5 lb-ft is produced at 2,400 r.p.m. Piston noise is kept to a minimum by offsetting the gudgeon pin axes from the cylinder axes. Among the changes made since the unit was first introduced are an increase in the fan diameter, with an appropriate reduction in its speed by means of a larger pulley, and complete redesigning of the exhaust system. On the Series 2 models, the radiator is about 5 per cent larger than before, and is mounted lower and further forward.

As with the earlier version, the Victor Super is more elaborately equipped and decorated than the standard model. The specification of all the Series 2 vehicles includes two-speed electric windscreen wipers; these, however, leave a considerable area unwiped in the middle, a point that is difficult to overcome with a wrap-round screen. Thermal interrupters are fitted in the lighting and wiper circuits to prevent any damage to the system through overload.

Sparking Plug Development

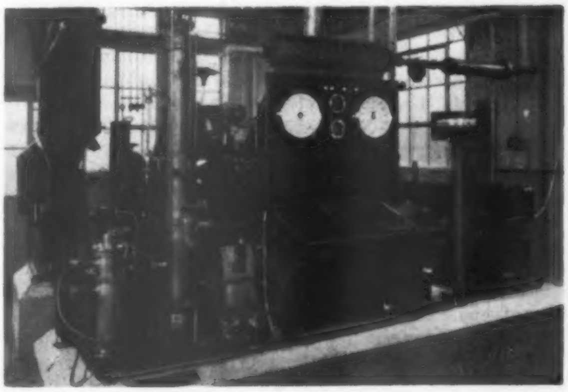
IN THIS country, much of a vehicle's running life is spent in traffic conditions, where full throttle is rarely held for more than a few seconds at a time. Combustion chamber temperatures therefore are relatively low. Although, under these conditions, the sparking plugs must run hot enough to prevent fouling, they must also be able to withstand, without overheating, the prolonged spells of high-speed running that will become increasingly possible as the new roads are completed. As power outputs become greater as a result of engine and fuel developments, the maximum operating temperatures will depart further from the traffic running temperatures. In other words, a wide heat range will become increasingly necessary for the plugs.

The problem of extending the heat range is receiving considerable attention at the K.L.G. factory at Putney Vale. While much can be learned from bench test programmes on actual vehicle engines, such tests are limited in scope because of the difficulty of making major alterations required to vary the operating conditions. For this reason, extensive use is made of a Heron heat rating machine, which permits the severity of the conditions to be varied as required during running. The Heron engine, a 17·6 in^3 single-cylinder unit, was originally developed for fuel octane rating work but has now, of course, become the S.A.E. standard means of assessing plug heat values.

Petrol injection is employed on the Heron and it is fed with purified air, at a fixed temperature. The air is precompressed and the boost pressure can be controlled by a valve. Because of the need to withstand pre-ignition, and the attendant high pressures, the connecting rod and big end bearing are unusually robust. To deal with the elevated temperatures attained, the piston crown and valves are sodium cooled. A thermocouple in the cylinder head permits readings corresponding to plug temperatures to be taken.

The engine is run at 2,700 r.p.m., this being an S.A.E. standard speed that has been found to give the least favourable plug heat reading. During the test, the boost is increased by $\frac{1}{2}$ lb/in^2 at a time, with intervals to allow conditions to become steady and instruments to be read, until pre-ignition takes place. The onset of pre-ignition is indicated by a sudden increase in the plug temperature, from about 600 deg C to 800 deg C or more. The amount of boost needed to cause pre-ignition is a direct measure of the heat value of the plug.

As can be seen from the accompanying illustration, the instrumentation of the Heron equipment is comprehensive. It includes a Cambridge temperature indicator, a large induction pressure gauge and a tachometer, also gauges for engine and brake coolant temperatures, and oil and air temperatures. For the convenience of the testing staff, a desk for the recording of results is installed on the test rig.



This Heron machine is extensively used by K.L.G. Sparking Plugs Ltd., to ascertain plug heat values under controlled operating conditions

Mond Nickel Fellowships

APPLICATIONS are now invited by the Mond Nickel Fellowships Committee for the award of the Fellowships for 1959. The purpose of the Mond Nickel Fellowships is to give additional training and experience to selected applicants of British nationality who are educated to university degree or equivalent standard. By such additional training, the recipients will be better qualified to hold executive or administrative positions in the metallurgical industry.

There are no age limits for the Fellowships, but they are seldom awarded to persons above the age of 35. Each Fellowship is valid for one full working year, and it is hoped to award five each year. The approximate value of a Fellowship is £900 to £1,200. Applicants will be required to give details of the programme of training in respect of which they are applying for the award, as well as particulars of their education, qualifications and previous career. Further information and application forms may be obtained from the Secretary, Mond Nickel Fellowships Committee, 4, Grosvenor Gardens, London, S.W.1. The closing date for the submission of application forms is 1st June 1959.

CONTINENTAL DESIGN TRENDS*

Some of the Factors Influencing the Design of Heavy Commercial Vehicles in Europe

In Western Europe the number of motor vehicles on the roads is growing rapidly. Between 1950 and 1955, there was an increase of about 75 per cent in passenger cars, buses and trucks, and between 1955 and 1960 there will be a further rise of more than 50 per cent. The augmentation in the volume of railway freight transport from 1950 to 1955 was only 16 per cent, and the increase during the succeeding five years is expected to be of the order of 10 per cent. On the 1st January, 1958, of the 25,000,000 trucks and buses that were circulating in the world, 8,000,000 were in Europe.

In 1946 the volume of road transport freight carried in Holland, for instance, mounted to 1,914,000,000 tonne-km, and by 1956 it was 3,562,000,000 tonne-km, the increase being 85 per cent. During 1957 the Netherlands State Railway transported 15,905,000 tonnes of freight and 189,400,000 passengers. At the same time, the road transport services hauled 70,200,000 tonnes of freight and 348,000,000 passengers. These figures give some idea of the trends in demand for commercial vehicles.

In general, there is little fundamental difference, with regard to the overall design and construction of transport vehicles, as between different countries round the world, except where comparison is made between vehicles in use on the North American Continent and other countries. However, factors such as climate, geographical conditions, local demands and preferences entail differences in detail. Transportation in the oil fields is in an entirely different category, because the carriage of heavy equipment over undeveloped territories can only be effected by special vehicles, and these are manufactured in very small numbers. In the discussion that follows, only conventional transport vehicles will be considered, the minimum payload capacity of which is 7 tonnes, and which are currently available on the European Continent.

Statutory regulations

Because of the ever increasing density of traffic, and owing to economic pressures tending to increase load carrying capacity of individual vehicles, statutory regulations are playing an important part in the determination of design specifications with regard to performance, capacity and overall dimensions. For example, in Germany, drastic restrictions came into force on the 1st January, 1958. Some of the most important of these are as follows:

1. The G.T.W., which for a tractor with semi-trailer and for a truck with trailer used to be limited to 35 and 40 tonnes respectively, has now been reduced to 24 tonnes; the trailer must not be heavier than the truck.
2. The G.V.W., which was 16 tonnes for trucks or buses, both with two axles, has now been reduced to 12 tonnes for trucks only.
3. The maximum permissible load for two axles (tandem axle) is now only 12 tonnes, while the maximum weight of three or multi-axle vehicles is 18 tonnes.
4. The maximum length of a truck with three axles should be not in excess of 32 ft (10 m) instead of 39 ft (12 m).
5. The maximum length of a truck with trailer has been reduced from 65 ft (20 m) to 46 ft (14 m), while the overall length of a tractor with semi-trailer has only been reduced from 46 ft (14 m) to 42 ft (13 m).

With regard to the technical aspects of construction, the German traffic legislation lays down that a truck, or a truck with trailer, weighing in excess of 9 tonnes, or a bus weighing more than 5 tonnes, must have an exhaust brake. When the vehicle is negotiating a bend in the road, the overall width occupied by the track of the tractor and semi-trailer or trailer must not be more than 18 ft. Finally, German trucks are required to have engines producing a minimum of 6 b.h.p./tonne weight of the tractor and trailer; this latter regulation is not enforced so far as vehicles of foreign manufacture are concerned. All vehicles put into operation for the first time after the 1st January, 1958 have to meet these new requirements, while existing vehicles have to meet them by the 1st January, 1960. These regulations tend to favour the semi-trailer, and the author criticizes the arbitrary interference with the economic and technical factors that would otherwise lead to more natural development of road transport.

POWER OUTPUTS RELATIVE TO LADEN WEIGHTS

	B.h.p.	G.V.W.	B.h.p./tonne
Berliet GLR	125	16·5	7·7
DAF A1500	120	11	11
DAF A2000	165	15	11
Fiat 682N2	150	18	8·4
Magirus Jupiter	170	14	12
Mercedes L333	200	16	12·5
Willème 615	175	26	6·8

Forward control

These legal regulations that have come into force in a large area of Central Europe are leading to even greater interest than hitherto in forward control layouts. In this connection there is still much to be desired so far as design is concerned. One of the disadvantages of this layout is the fact that there is generally only one seat available in addition to that for the driver. Another is that since the seats in the cab are relatively high above the front axle, which is an instantaneous centre in respect of certain modes of ride vibration, the seat is subject not only to vertical movements but also to horizontal ones. This is why seat arrangements in this type of vehicle have been the subject of so much experimentation.

The most important advantages of the layout, of course, are the excellent range of visibility from the cab and the high proportion of the overall length of the vehicle that is available for the pay-load. Another advantage is that it is more practical with the cab over engine layout to fit a bunk behind the driver and the passenger; for operation on the Continent this is an important feature, because of the long

**Abstracted from a paper by Jhr. A. R. J. van der Goes, of Van Doorne's Automobielfabriek N.V., presented in London at a meeting of the Institute of Road Transport Engineers, on 22nd January, 1959.*

distances covered and the fact that the crew may have to spend nights away from home.

Despite the advantages of the cab over engine design, it would appear that at least for many years there will be a demand for the normal control layout. With this layout, engine noise and fumes are more easily kept out of the cab, and the forward engine installation tends to give the driver more protection in the event of an accident. Moreover, with this type of arrangement, there is more space in the cab for the crew.

The engine

The demand for increased engine power has developed steadily over the years. It has arisen not only because of the trend towards higher payloads but also because of the increasing density of traffic. In the fully laden condition, the power : weight ratio is generally 7 to 9 b.h.p./tonne but sometimes is in excess of 10 b.h.p./tonne, as can be seen from the accompanying table. Where trailers or semi-trailers are employed, the overall power : weight ratio is in general 6 b.h.p./tonne. Since, as has already been mentioned, the overall power : weight ratio of 6 b.h.p./tonne is a legal requirement in Germany, trucks manufactured in that country generally have relatively powerful engines. For the truck alone, the power : weight ratio is generally about 12 b.h.p./tonne. Turbocharging is becoming popular and it is felt that the demand for this arrangement will increase as turbocharger units become available in larger numbers. The advantages of turbocharging are, of course, that under many conditions of operation, fuel economies can be effected, and the improvement in power output is obtained without materially increasing the length of the engine installation.

It is of interest to note that a number of European manufacturers are employing the V-type engine. Among these are Magirus Deutz, MWM and Tatra. In France, Bernard have recently introduced a 200 b.h.p. V-type engine, which is air cooled. Air cooled engines of other layouts are manufactured in Germany, by MWM and Magirus Deutz, and in Czechoslovakia, by Praga and Tatra.

Gearboxes

In connection with gearbox design, the aim is at simplifying the work of the driver by reducing the demands on his skill and concentration on physical tasks. Another advantage obtained by this simplification is a reduction in maintenance costs, since the mechanical components of the transmission and engine are less likely to be subject to improper treatment. Owing to the development of tyres of higher carrying capacity, and since trailers are used more widely as motorways are extended, the capacity of gearboxes is steadily being increased. At present the range of ratios for heavy commercial vehicles is of the order of from direct drive to 10 : 1, and this spread is necessarily accompanied by increases in the number of ratios available to 5, 6 or even more speeds. Contrary to earlier ideas, at least two speeds lower than the direct drive must be suitable for long periods of operation. On the other hand, in many gearboxes the highest-but-one gear is the direct drive. In general, the overdrive is selected for operation when the vehicle is empty and is required to operate at high speeds for long distances.

As the number of ratios is increased, so also are the demands on the driver. It seems likely, therefore, that power assisted gear shifting devices will become more popular. Dog clutches are generally employed for the selection of the highest and most frequently used speeds, since engagement with this arrangement is more easily effected than with sliding spur type gears. For public service vehicles, dog clutch engagement is even more widely adopted than for trucks. Since this type of vehicle chassis is generally very different from that of a truck, and the gearbox is generally a greater distance from the driver, remote control is necessary. This not only calls for power assistance by means of air pressure, vacuum or hydraulic pressure, but also the gearbox has to be fully synchronized because of the lack of feel of the control experienced by the driver.

Since the refinements already mentioned represent additional complication and cost, it is probable that the demands for them will vary as between one country and another. For example, a wider range of ratios obviously will be necessary in mountainous than in flat countries, especially where the roads are good. In some instances, a two-speed auxiliary gearbox or a two-speed axle may be the best solution to the problem. For city buses, where only a moderate top speed is required, a reduction of between 3·5 : 1 and 4·5 : 1 is sufficient, provided there are not any exceptionally steep hills on the routes.

Since, by combining the main and auxiliary gearbox, additional ratios can be obtained with a minimum of wastage of space, a number of manufacturers, for instance, Saurer, have adopted this method of obtaining double the number of ratios that would otherwise be available. For buses, the ease of gearshifting can be improved by the employment of gears that can be shifted under load. This is done by ZF, for example, by electro-magnetically actuated friction clutches. A hydro-mechanical gearbox is also being manufactured in Europe. It comprises a torque converter, which is used for moving off from rest, after which the normal gears are used to obtain the higher speed range. The greatest obstacle to the introduction of more advanced gearboxes is that of cost.

Axles

As has already been mentioned, two-speed axles can be employed to increase the number of gear ratios available, but they have disadvantages. One is high price and another is the increase in axle weight and, therefore, riding qualities. The new regulations in Germany will lead to even greater interest in the application of a third axle, since it will enable operators to carry an additional 6 tonnes. In fact, to meet the expected demand, many European manufacturers have introduced trucks with tandem axles.

For passenger transport on relatively poor roads between small villages, DAF have developed a bus chassis, the type B3000, with a tandem rear axle layout. With this design the front axle load is 3,500 kg (7,717 lb) and the load on each rear axle is 4,800 kg (10,584 lb). With its full load of passengers, the G.V.W. of this bus is 13,100 kg (28,885 lb).

On the Daimler Benz LP333 truck, the load on each of the two steered front axles is 4 tonnes and, therefore, power steering is employed; the load on the single rear axle is 8 tonnes. In general, power steering becomes desirable when the load on the front axle exceeds 3,500 kg (7,717 lb).

Air suspension

Despite the relatively short period of development of air suspension, satisfactory results have already been obtained. The life of the elements has been shown by experience to be at least 50,000 to 60,000 miles and they need almost no maintenance. Since there is practically no inherent damping in air springs, some manufacturers have found it necessary to employ two shock absorbers for each wheel. Most of the suspension units currently used on the Continent have been developed in co-operation with tyre manufacturers such as Dunlop Rubber Co. Ltd., Firestone Tyre and Rubber Co. Ltd., and General Tyre and Rubber Co.

The new Daimler Benz Grossraum bus, type 0·317, has two air spring elements on the front axle and four on the rear axle. Inside each is a hard rubber bump stop, which serves as an emergency spring should the air pressure fail.

The front axle is located by means of three arms, one transverse and two longitudinal, and the rear axle is similarly located. Four telescopic shock absorbers are employed on each axle. On the Henschel HS 160 USL bus, there are also two air spring elements at the front and four at the rear. However, in conjunction with the air springs, leaf springs are employed to locate the axles and to carry part of the weight of the vehicle.

Controls and brakes

Controls play an important part so far as safety is concerned. In Germany, as has already been stated, trucks with a G.V.W. of over 9 tonnes and buses of over 5 tonnes must have an exhaust brake. It has to be borne in mind, however, that gear changing with the exhaust brake in operation would be hazardous, if after the clutch pedal has been depressed, the engine stops and the driver can no longer engage any gears. This danger can be obviated by arranging for the exhaust brake to be operated by means of the left foot so that when the left foot is used to depress the clutch pedal it cannot be operating the exhaust brake at the same time. Where the G.V.W. exceeds 12 tonnes an auxiliary device is required for the operation of the hand brake. It is for this reason that many European manufacturers have introduced double pull type hand brakes.

Bibliography

1. A. P. HOYNCK VAN PAPENDRECHT: "Nieuwe Duitse verkeerswetgeving", *Dafblad,* 1958 No. 2.
2. W. FICK: "Die cockpit op het DAF chassis", *Dafblad,* 1957 No. 3.
3. Press release, "Daimler-Benz LP 333 mit hoher Nutzlast".
4. N. L. ERPELDING: "Les problèmes techniques que pose le Salon", *Poids Lours,* 1958 No. 520.
5. A. MAIR: "Entwicklungen im Nutzfahrzeug-Getriebebau", *A.T.Z.* 57, 1955.
6. "Luftfederung in Deutschen Nutzfahrzeugen", *Autom. Rev.* 53, 1958.
7. Pamphlet, *Henschel* KA 819-1.4.1958.
8. A. P. HOYNCK VAN PAPENDRECHT: DAF combineert luchtvering en onafhankelijke wielophanging", *Dafblad,* 1957 No. 4.

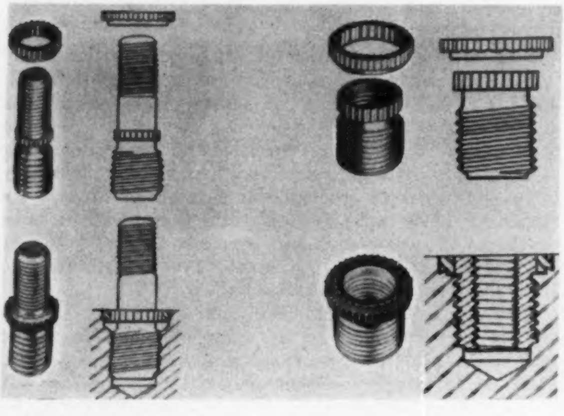
Rosan Screwed Inserts

ONE OF the difficulties with which engineers are faced when using soft alloys such as aluminium, magnesium or zinc, is that it is unwise for studs or set bolts to be screwed into the components if there is any likelihood of their being removed and replaced by unskilled labour. In any case, if the components are dismantled regularly, the threads tend to wear and finally strip. To overcome this problem, the Instrument Screw Co. Ltd., of Northolt Road, South Harrow, Middlesex, produce Rosan Permanently Locked Studs and Inserts.

These are similar to the more conventional components except in that a serrated collar is formed on both the stud and the insert. As can be seen from the accompanying illustrations, the collar on the stud is immediately above the threaded portion that is screwed into the soft metal. On the inserts, for receiving set bolts, the collar is similarly positioned relative to the external thread but, of course, it is at the outer end of the insert, which is internally threaded to receive the set bolt.

The Rosan stud or insert is screwed into a hole in the soft metal component. This hole is countersunk to receive an internally and externally serrated lock ring, which is assembled over the stud or insert until its internal serrations engage with those on the stud or insert. Finally, the ring is driven into the soft metal, where it is accommodated in the countersink at the top of the hole. Its outer serrations, which are undercut to form broaches, cut their way into the soft metal as the ring is driven home until it is flush with the surface of the metal.

The diagrams on the left illustrate Rosan studs, which can be screwed into their holes and locked; those on the right show inserts for use in soft metals where set bolts have to be used to secure components



Should it become necessary to remove the stud or insert, it can be replaced with either an identical unit or a larger one. In the event of a design change, or for any other reason, a solid blank can be fitted to save the scrapping of an otherwise serviceable component.

Standard drills and taps are used for preparing the component for receiving the Rosan unit. Both the studs and the inserts are manufactured slightly oversize in diameter, to ensure that they fit firmly. Simple wrenches and punches are available for the installation of the inserts, studs and locking rings, but even these are not regarded as essential.

Among the advantages of the Rosan system is the fact that, since the teeth of the locking rings are in the form of broaches, they cut through the metal, thus avoiding distortion and local stressing. The components are suitable for application where positive locking is required under conditions of vibration, high stress or temperature changes. They are also capable of taking relatively high torques, and are especially useful where locking type nuts are employed, or where the nuts or bolts may become rusted, corroded or mechanically jammed and have to be forcibly removed.

Carpet Binding

A NEW product known as Jiffybind has been introduced recently. It can be used to protect the edges of all types of carpeting against fraying, and thus it obviates the need of binding tape or sewing. Jiffybind is a self-sealing liquid paste that is applied from a tube to the upper and lower surfaces of the carpet edge, for a width of about 1 in, and then allowed to dry. For coconut matting, a 2 in width of application is recommended, while the Axminster type of carpet is bound by fraying the edge for about 1 in, applying Jiffybind to the back, and pressing the frayed ends on to it. The paste is available in a wide variety of colours and is manufactured by D. C. Loncraine and Co. (Jiffytex) Ltd., whose address is Barrow Works, Pewsey, Wiltshire.

Supplement 1 Oil

Benefits Obtained by the Use of this Oil in Petrol Engines

JUDGING from the results of recent tests conducted in the laboratories of one of the additive manufacturers, petrol as well as diesel engines can benefit from lubrication with detergent oils to the U.S. Defence Department specification 2-104B Supplement 1, which though now obsolete is still recognized. Apparently, private car petrol engines, especially the smaller ones, when lubricated with oil to Supplement 1 standard, often show wear rates almost half those experienced when running on a straight oil. Another important fact that was demonstrated was that an improperly formulated multigrade oil can give worse results than one of single viscosity.

Thirteen engines were involved in these tests. The service conditions were selected to promote cold sludging and acid formation, as against the more normal high speed-load tests. Four oils were used for the comparative tests: a straight untreated S.A.E.20, a Supplement 1 S.A.E.20, a 10W/30 untreated multigrade, and a 10W/30 multigrade to Supplement 1 standard. The investigations into the behaviour of each of the four oils were carried out by using them in a Morris Minor, 803 cm^3, overhead valve, four-cylinder engine and a Hillman Minx, 1,390 cm^3, overhead-valve, four-cylinder unit. In addition, two Triumph TR2, 1,997 cm^3, overhead-valve, four-cylinder and two Vauxhall Velox, 2,230 cm^3, overhead-valve, six-cylinder engines were run on S.A.E.20 straight oil and S.A.E.10W/30 multigrade to Supplement 1 standard of detergency.

All these engines were operated in vehicles driven under carefully controlled conditions, 40 m.p.h. and 100 miles per day never being exceeded. As a further precaution, the drivers were changed every fortnight. The vehicles were always parked in the open. Engine oil was drained and replenished every 2,500 miles, and filters changed every 5,000 miles. To provide some comparison with more normal operating conditions, a Morris Minor Traveller's Car, in normal use, was also run on Supplement 1 S.A.E.20 oil.

Table 1—INSPECTION DATA ON OIL BLENDS TESTED

Grade	*S.A.E.20*	*S.A.E. 10W/30*	*S.A.E.20 Supp. 1*	*S.A.E. 10W/30 Supp. 1*
Additive treatment	0·85% pour point depressant Z	7·0% V.I. improver Y	3·75% additive X, 0·85% pour point depressant Z	5·0% additive X, 7% V.I. improver Y
Specific gravity	0·882	0·877	0·887	0·888
A.P.I. gravity	28·9	29·8	28·0	27·9
Flash point, COC, deg F	455	410	460	425
Pour point, deg F	—5	—35	—5	—35
Carbon residue, Ramsbottom, % wt.	0·07	0·10	1·09	1·40
Viscosity, at 210 deg F, cS	9·10	11·77	9·33	12·30
Viscosity, at 100 deg F, cS	79·43	71·35	79·69	77·74
Viscosity, at 0 deg F, cS	7,500	1,850	7,000	2,500
Viscosity index	97	141	101	138
Total acid No. mgm, KOH/gm	0·08	< 0·02	1·7	2·5
Total base No. mgm, KOH/gm	0·02	< 0·02	3·1	4·2
Sulphated ash, % wt. at 525 deg C	Nil	Nil	1·15	1·53
at 775 deg C	Nil	Nil	1·10	1·46
Barium, % wt.	Nil	Nil	0·54	0·73
Zinc, % wt.	Nil	Nil	0·088	0·109
Phosphorus, % wt.	Nil	Nil	0·101	0·125
Sulphur, % wt.	—	—	1·13	1·18

The results with the latter vehicle were little different from those obtained with one of the controlled-test Morris Minors running on a similar oil.

Tests were begun at the latter end of 1955, the cars being acquired earlier in the same year. Before the tests, each engine was dismantled and all components likely to be subject to wear were measured, the data being recorded as a basis for comparison at the end of the experiment. Any components showing signs of scoring or damage or which were outside their manufacturer's tolerances were replaced.

Table 2—OVERALL FUEL AND OIL CONSUMPTION

Car type	*Oil S.A.E. grade*	*Miles completed on test*	*Overall petrol cons., m.p.g.*	*Overall oil cons., m.p.qt.*
MAKE A	20	25015	38·9	817
	10W/30 Supp. 1	24994	39·2	5433
	10W/30	24993	39·1	1983
	20 Supp. 1	24991	38·5	1315
MAKE B	20	24992	30·1	1505
	10W/30 Supp. 1	24990	30·3	1922
	10W/30	24993	29·8	1724
	20 Supp. 1	24992	29·5	1724
MAKE C	20	25011	25·8	2084
	10W/30 Supp. 1	25005	26·1	848
MAKE D	20	24994	28·2	1851
	10W/30 Supp. 1	24989	29·1	1983
MAKE A (Uncontrolled)	20 Supp. 1	24984	40·3	2498

Assembly was selective so that clearances on engines of the same types were as nearly identical as possible.

The repeated heating and cooling of the engines, occasioned by the short distance work, was intended to produce internal condensation and conditions of boundary lubrication when starting up. Such conditions are often met in service and, as expected, emphasized the worth of detergent oils in dealing with acidic sludge-promoting conditions, as against constant load and speed test procedures on the test bench, where the value of detergent oils has already been proved.

In addition to the oil and filter changes, the cars were subjected to routine servicing at 1,250-mile intervals. No repair work was undertaken unless it was strictly necessary, for example, as it was when two of the test vehicles, one running on straight S.A.E.20 oil and the other on S.A.E. 10W/30 multigrade Supplement 1 oil, developed exhaust valve burning after 10,000 miles. These failures were attributed to sub-standard materials, and all the exhaust valves were replaced on these two engines. None of the other engines showed any noticeable drop in performance and, except on the Morris Minor and Hillman Minx engines running on straight oils, no appreciable increase in oil consumption was detected during the 25,000-mile test. Piston slap was becoming evident only on engines running on the S.A.E.20 and 10W/30 straight oils that were used.

Table 3—WEAR MEASUREMENTS, EXPRESSED IN THOUSANDTHS OF AN INCH, AS OBTAINED WITH DIFFERENT OILS THAT WERE USED IN THE TEST VEHICLES

	Hillman 1·38-litre			
	S.A.E.10W/30 Multigrade Supplement 1 Detergent	*S.A.E.20 Straight*	*S.A.E.10W/30 Multigrade Straight*	*S.A.E.20 Supplement 1 Detergent*
Increase in cylinder bore diameter at top	2·0	3·8	4·0	1·6
Increase in top ring side clearance	2·0	2·0	2·2	2·2
Increase in top ring butt gap	11·0	24·0	16·0	9·0
Increase in piston boss internal diameter	0·5	0·3	0·1	0·1
Decrease in tappet effective length	0·6	10·6	7·2	4·1
Indentation of rocker pads	0·4	1·5	0·8	Nil
$\frac{\text{Increase in timing chain length}}{100}$	0·6	1·2	3·1	3·4
Increase in valve guide internal diameter	0·9	0·5	0·5	0·4
Decrease in valve stem outside diameter	Nil	Nil	Nil	0·1
Increase in tappet sleeve internal diameter	0·3	0·5	0·3	0·3
Main journal wear	Nil	0·1	0·5	Nil
Crankpin wear	Nil	0·1	Nil	Nil
Total wear of cylinder bore group	16·1	30·8	22·9	13·5
Total wear of bearing group	11·7	3·6	3·0	5·5
Total wear of valve train group	3·2	14·5	10·9	6·6
Total wear of auxiliaries group	15·5	19·7	12·9	12·1

During the tests, little difference in fuel consumption, as between engines of the same make, was observed no matter which type of oil was used. Probably the effective difference in viscosity between the S.A.E.20 and the S.A.E.10W/30 oils, was not sufficient to allow the multigrade oils to show any great advantage. If the comparison had been with S.A.E.30 oil, there might have been observations slightly more in favour of the 10W/30 oils.

When the engines were stripped after the tests, the comparative cleanliness of those run on detergent oil was immediately apparent. Both the sludge deposits and the coating of varnish were largely absent from the engines run on additive-treated oil. The detergent oils also conferred benefits in respect of engine wear. In general, the cylinder bore wear was twice as much in the engines run on straight oil as in those operated on detergent oil. And the least wear rates were occasioned with Supplement 1 S.A.E.20 oil. The worst wear occurred in engines lubricated with the straight S.A.E.10W/30 multigrade oil. It was noticed that the biggest differences were shown in the smallest engines. This was probably because these engines were working harder under the test conditions, and the loadings were therefore higher. Distributor-drive gear wear was severe with one type of engine, but in all cases additive treatment reduced the wear rate. Combustion chamber deposits, though varying slightly in quantity, were of similar character.

Table 4—WEAR MERIT RATINGS

	Hillman	*Morris*	*Vauxhall*	*Triumph*
S.A.E.20 straight	62·1	52·9	59·1	76·8
S.A.E.10W/30 straight	66·1	55·2	—	—
S.A.E.20 detergent	73	72·3	—	—
S.A.E.10W/30 detergent	63·5	65·7	74·0	72·4

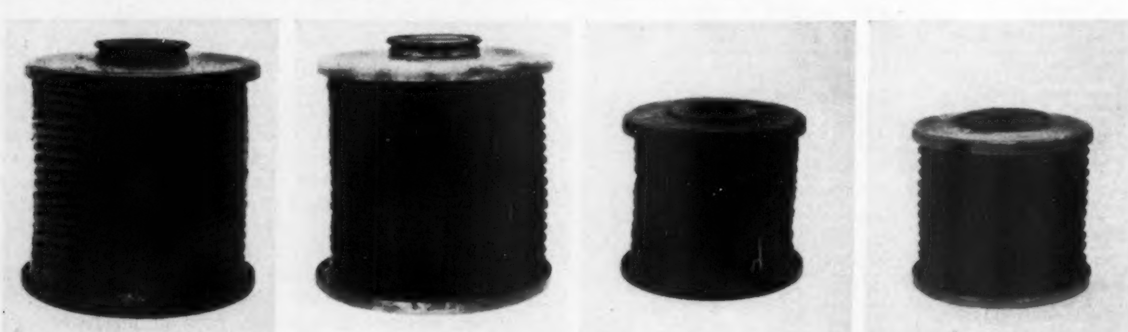
It was obvious that the worst sludging occurred when a straight multigrade 10W/30 oil was used. In view of the lack of any improved road performance of the cars run on multigrade oil, the tests showed that there is no point in using a straight oil treated with polymers to increase its apparent viscosity with rises in temperature. Operation with oils of this type was included in the series of tests only for interest, since most oil companies always incorporate antiwear additives in them. Even if there should be some slight improvement in performance it is nullified by the extra sludge, higher rate of wear and more rapid lowering of efficiency. In order of credit, the performance of the oils was: Supplement 1 S.A.E.20, Supplement 1 S.A.E.10W/30, straight S.A.E.20 and straight S.A.E.10W/30.

The inclusion of a Morris Minor Traveller's Car in the test, although it was not subjected to the controlled conditions, was a wise move. It enabled a comparison to be made between the states of the controlled-test engines and an engine used more normally. The lack of restriction of speed in the case of the Traveller's Car engine meant that it exhibited slightly more wear, and this was attributable to higher inertia loading. In general, however, the wear was of the same order as the controlled-test Minor that was also run on Supplement 1 S.A.E.20 oil. The success of the Traveller's Car performance on this grade of lubricant underlined the value of Supplement 1 oil.

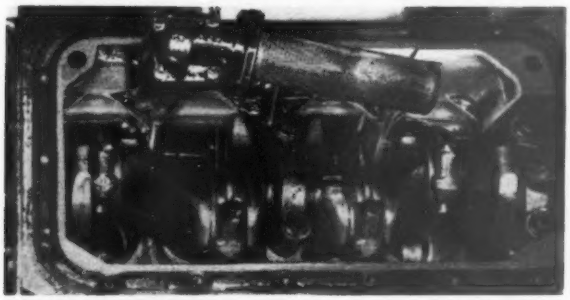
Multigrade oil was shown to be largely undesirable, unless properly treated with detergent additives. The build-up of sticky black carbonaceous deposits on the backs of valves was shown to be so serious as to affect adversely an engine's breathing if no detergents were present in the oil. Sludge formation was so heavy on the primary gauze filter of one engine that it became completely blocked.

From the test results it would appear that an aspect of

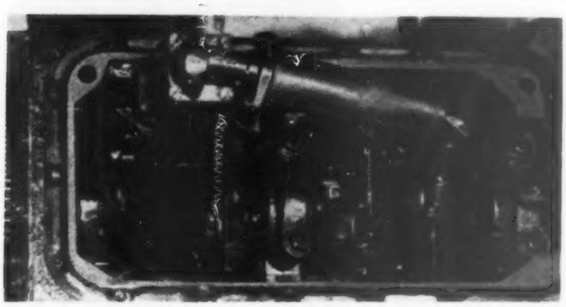
Filters after use with, from left to right, S.A.E.20, straight; S.A.E.10W/30, Suppl. 1; S.A.E.10W/30, straight; and S.A.E.20 Suppl. 1 oils



Morris 0·803-litre					Triumph 1·99-litre		Vauxhall 2·23-litre	
S.A.E.10W/30 Multigrade Supplement 1 Detergent	*S.A.E.20 Straight*	*S.A.E.10W/30 Multigrade Straight*	*S.A.E.20 Supplement 1 Detergent*	*S.A.E.20 Supplement 1 Detergent (normal operation)*	*S.A.E.20 Straight*	*S.A.E.10W/30 Multigrade Supplement 1 Detergent*	*S.A.E.20 Straight*	*S.A.E.10W/30 Multigrade Supplement 1 Detergent*
3·1	6·5	8·4	2·8	2·5	2·1	2·3	3·7	0·7
7·8	10·7	3·1	5·2	10·8	0·3	0·5	1·0	1·0
18·0	42·0	16·5	30·0	17·3	19·0	10·0	30·0	15·0
0·2	0·3	0·5	0·3	0·4	Nil	Nil	0·2	0·1
3·0	3·6	3·2	1·6	1·6	5·8	8·3	4·3	4·7
0·7	1·0	0·9	0·5	1·0	Nil	Nil	1·0	0·6
3·6	3·4	6·2	5·9	3·1	3·1	3·1	3·0	3·0
0·9	0·8	0·7	0·6	2·2	2·8	1·2	0·3	0·6
0·5	0·5	0·2	0·2	0·3	0·1	0·3	0·5	0·5
0·4	0·3	0·2	0·5	0·2	Nil	0·3	0·5	0·6
Nil	0·4	0·6	Nil	0·1	Nil	Nil	0·2	Nil
Nil	0·9	0·8	Nil	0·4	Nil	Nil	0·3	Nil
29·1	59·8	28·6	38·3	31·2	21·8	13·0	35·4	17·0
4·4	8·0	4·7	1·1	4·1	2·3	1·5	6·4	5·9
8·1	10·5	9·9	4·8	13·1	12·3	11·7	11·7	8·5
6·3	6·4	9·8	9·4	6·2	4·9	5·5	5·8	4·7



The illustrations above and below show respectively the difference, so far as cleanliness is concerned, between the crankcase of an engine operated on S.A.E.10W/30, Supplement 1 oil and the same crankcase when the engine was run with S.A.E.20, straight oil in the sump



engine design that calls for improvement is bearings. On many of the engines, there was no measurable wear of the main bearings and they were all in good condition after the 25,000-mile test. Practically all the big end bearings, on the other hand, showed sign of stress and in many cases there was fretting and rupture of the bearing material. In one design of engine, the big end of the connecting rod was offset from the major axis of the rod and there was insufficient metal to spread the load from the axis of the rod over the whole bearing width. The result appeared to be that, under load, deflection of the overhanging portion of the bearing was causing most of the load to be taken by that part of the bearing directly beneath the axis of the rod, where severe local fretting occurred.

It is of interest to note that fretting was more severe on engines running on Supplement 1 oil. With straight oils there seemed to be some benefit derived from the varnish deposited on the bearing surfaces. This poses a problem for the oil technologist: how to keep a protective varnish coating on the bearings yet at the same time prevent it forming on pistons. It could perhaps be solved by using an additive effective in scouring lacquer at the high temperatures encountered on cylinder walls yet remaining ineffective at the relatively cooler bottom part of an engine. But the problem is much more appropriately a mechanical one. In the first place it seems likely that in many instances an increase in big end bearing area could be made at the expense of that of the main bearings, without altering the overall length of the crankshaft. Whereas big ends are overloaded, the mains are apparently working well within their ultimate limit.

Careful design of connecting rods is called for to ensure that the loads are distributed over the bearing surface. Tougher materials, such as lead-indium, aluminium-tin, and copper-lead, now seem to be needed for modern engines, in which indicated cylinder pressures greater than hitherto are obtained. As copper-lead becomes more widely used for petrol engine bearings, so should the employment of detergent oils increase. Otherwise the acid erosion of copper-lead might be a problem as it has been with diesel units. There is also evidence of poor pressure distribution on pistons.

During the initial dismantling for measurements before the tests, two engines had to be sent back to the manufacturers. Cases of badly scored valve stems were discovered, and some parts were already outside the manufacturers' tolerances. These facts indicate that, in some factories, tightening of quality control is needed.

The experiments described have not only fulfilled their primary object of proving the value of additives in oils, but have also underlined the necessity for suitable additive treatment of multigrade oils. Moreover, they have highlighted certain inherent weaknesses of mechanical design.

Technical Dictionaries

A CATALOGUE of technical dictionaries has recently been published by Bailey Brothers and Swinfen Ltd., of Hyde House, West Central Street, London, W.C.1. It covers more than 180 subjects in a wide range of languages. The subjects are listed alphabetically throughout the catalogue. Dictionaries that cover a large variety of subjects, and those that are not on a specific subject, are listed under the heading "General". Among the dictionaries under the heading "Motor Industry and Motoring" are works for the translation of technical terms in English, German, Swedish, Dutch, Croatian, Italian, French, Hebrew, Spanish, Portuguese, Norwegian and Russian. The catalogue is available free of charge from its publishers.

EXHAUST FUMES AND SMOKE

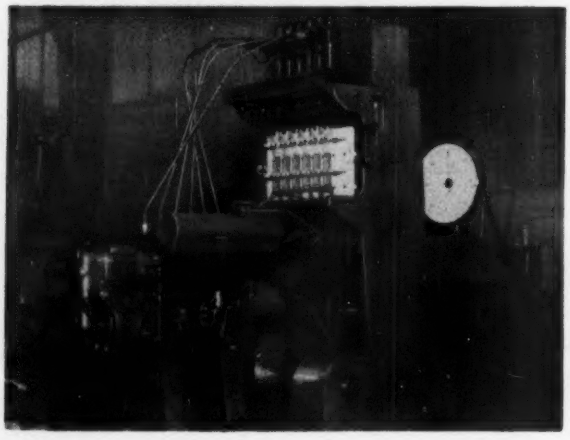
Methods Employed by London Transport Executive to Control and Measure Exhaust Polution

IN September 1958, an international conference on the technical inspection of motor vehicles was held in Brussels. One of the papers presented at the conference was entitled "The Control and Measurement of Fumes Emitted by Road Vehicle Engines", by A. T. Wilford, Director of Research, London Transport Executive. A point made early in the paper was the tendency to single out the diesel engine as the black sheep of atmospheric pollution, regardless of the parts played by the petrol engine and the combustion of solid fuel.

According to research in the U.S.A., the average petrol engine discharges about 7 per cent of its fuel intake in the form of unburnt hydrocarbons. Because carburettors are usually set to give an over-rich mixture for maximum power, a considerable proportion of carbon monoxide is inevitable. Owing to uneven distribution, even a chemically weak mixture can result in the emission of carbon monoxide. In contrast, even at the maximum acceptable smoke level, a diesel engine will discharge only 2 per cent of its fuel as unburnt hydrocarbons, and the gas contains very little carbon monoxide. Analyses of samples from London Transport buses gave a content of between nil and 0·066 per cent. However, the exhaust of a diesel engine that is smoking heavily can contain more than 7 per cent of carbon monoxide. Apart from the public resentment that it arouses, such smoke indicates a heavy wastage of fuel, so the vehicle operator has a strong incentive to minimize the nuisance.

In the days before London's buses had diesel engines, the authorities went to considerable trouble to ensure that their carburettors were set to give the lowest carbon monoxide content in the exhaust, consistent with satisfactory performance of the engine. For this purpose, exhaust gas samples were analysed, using the well-known Orsat analyser, modified to render it portable. Because of the low carbon monoxide content of diesel engine exhaust gases under normal conditions, a simpler apparatus is used, which determines only the proportion of carbon dioxide present. Samples are taken from the tailpipe of the exhaust system.

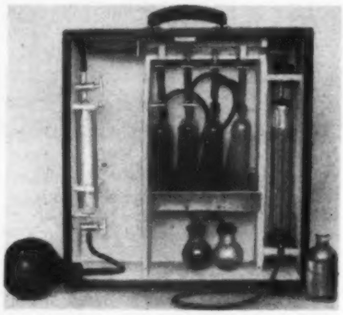
The Hartridge machine employed for the testing of fuel injection pumps; on it, the timing of the pump is set and the elements balanced



The main causes of diesel engine smoke are, of course, incorrect setting of the fuel pump and, to a lesser extent, poorly maintained injectors. Nowadays, the use of special equipment for testing and setting diesel fuel pumps has largely superseded the earlier method of running the vehicle on the road, taking exhaust gas samples for analysis and adjusting the pump as necessary. However, exhaust gas analysis is still used by London Transport for a system of rapid spot checks that does not involve the removal of the pump from the vehicle.

The equipment used for testing and setting injection pumps is the familiar Leslie Hartridge machine which is, in fact, a commercial development of one originally designed by

For the analysis of the exhaust gases of vehicles with petrol engines, this modified, portable Orsat gas analyser can be used

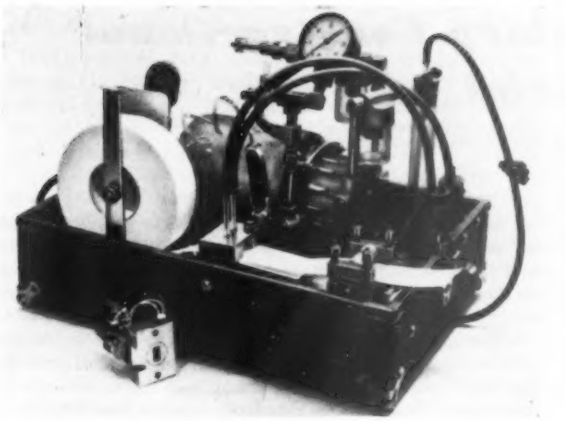


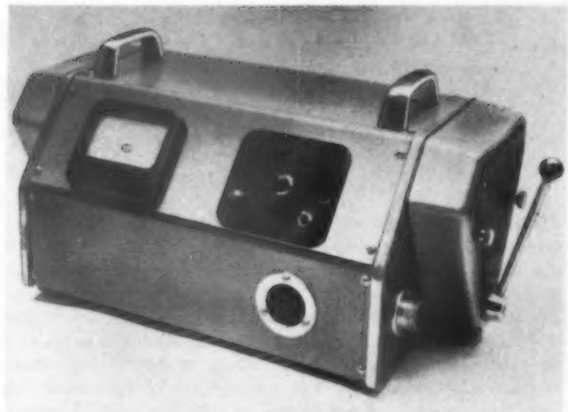
London Transport engineers. It permits the pump timing to be set and the output of the individual elements to be accurately measured, so that balancing can be carried out if necessary. The machines are set for operation at a pump speed of 600 r.p.m.; not only is this an average running speed in service conditions but it has been found that it is in the range over which the variation of output with speed is at a minimum. The machine is normally run on a special test fluid, a mixture of a light mineral oil and kerosine, because of the possibility of an operator being allergic to diesel fuel.

On the machines in use at the Executive's Central Overhaul Works, electrical contacts are used to provide an indication of the angular position at which each injector needle begins to lift. This refinement enables the pump elements to be correctly phased and the timing set by reference to No. 1 element. The test machines at the garages are for checking the output only, and in each instance this work is the responsibility of one qualified man. Any pump which fails to conform with the prescribed standard is returned to the overhaul centre for further investigation.

At present, the injectors are removed for cleaning and testing every 18,000 miles. Investigations over the last four years indicate, however, that this period can probably be considerably extended without adverse effect. The injectors are dismantled, carbon deposits are removed and the holes cleaned by means of a special D-shape needle. After reassembly, the injectors are tested for pressure, spray form, sealing and leak-off. Again, any failure results in the unit being returned to the overhaul centre.

The pump testing machines at garages are tested and





Two forms of apparatus for measuring the intensity of diesel engine smoke have been tried by London Transport: the American Van Brand meter, seen on the left, records on a strip of filter paper, whereas the Hartridge meter measures the amount of light obscured by the smoke

recalibrated every six months to ensure consistency of performance; this work is carried out by the Executive's research department. Each inspector is provided with a single-cylinder injection pump equipped with a reference injector checked at the Central Laboratory, against a master injector. The testing machines in the Central Overhaul Works are checked at least once a day against a six-cylinder master pump which, in turn, is checked each month by the research department. A six-monthly check is applied also to the injector testing machines and their pressure gauges.

Among the duties of the research department inspectors is the observation of the exhaust emission of buses on the roads; any instances of excessive smoking are at once reported to the garage concerned. Every three months, too, there is a large-scale survey of exhaust smoke in central London, during which some 800 buses are observed. It is, of course, difficult to assess smoke density quantitatively, by eye, except in very bad instances, and the weather conditions and the background affect the appearance of the smoke. The inspectors are therefore provided with a set of five reference cards, ranging from a slight haze to black. These cards are of considerable value to newcomers, but it has been found that the more experienced inspectors seldom require them.

To put the measurement of exhaust smoke density on a more scientific level, tests have been carried out for a number of months on two designs of smoke meter, the Van Brand and the Hartridge instruments. The first is of American origin and sucks a by-passed sample of the emission at a constant rate through a strip of filter paper moving at a pre-set speed. A stain is imparted to the paper and its intensity is proportional to the smoke concentration, which is measured either by reference to a standard chart or by means of a photoelectric reflection meter.

The Hartridge meter is a development of one designed by the British Petroleum Co., and gives a direct reading of the percentage of light obscured by the exhaust emission passing through a tube. At one end of the tube is the light source, and at the other end a selenium cell measures the light transmitted. Calibration is by reference to a similar tube containing clear air; to eliminate possible variables, the light source and the cell are transferred from one tube to the other by movement of a lever. These two meters have been used for bench tests and on test vehicles, and the Hartridge-B.P. design is in general the more convenient to operate.

Technical Education

THE INSTITUTION of Production Engineers has published a 264 page bibliography entitled "The Effect of Technological Progress on Education." Although the bibliography is not claimed to be comprehensive, it is thought that it should serve as a guide to the development of technical education during the period covered, 1945 to 1957, and also as a summary of opinion on the subject. It is believed that this is the only bibliography of its kind so far prepared. The publication is available from the Institution, at 10 Chesterfield Street, London, W.1, price 2s 6d per copy, or 3s 6d by post.

Reinforced Plastics

A REINFORCED Plastics Group has been formed by The British Plastics Federation and it is open both to manufacturers producing articles in reinforced plastics and to those who make the necessary materials and equipment for such production. The purpose of the group is to foster the growth of the reinforced plastics industry, to co-ordinate work on specifications and standards, and to investigate the long-term properties of these increasingly used materials.

A technical conference was held by the Federation at Brighton between 22nd and 24th October, 1958, at which a number of Papers were presented. Copies of these Papers and further details of the Reinforced Plastics Group are obtainable from The British Plastics Federation, 47 to 48 Piccadilly, London, W.1.

Lubrication by Grease

ALTHOUGH the use of grease in motor vehicles is confined these days almost exclusively to chassis lubrication, considerable quantities are used in industry. Some engineers tend to regard greases as fundamentally inferior to oil and are unaware that grease lubrication is as specialized a technique as oil lubrication. An interesting booklet entitled *Lubrication by Grease* has been published by Germ Lubricants Ltd., to indicate the wide variety of properties that can now be obtained in greases. The booklet is illustrated with many applications of grease lubrication and includes a list of the full range of Germ greases. It is obtainable on request from the head office of Germ Lubricants Ltd., Bloom Street, Salford, Manchester, 3.

EXPAMET—An Auxiliary Constructional Material

Varied Applications on Passenger and Goods Vehicles

A modern motor vehicle is remarkable for the number and diversity of the materials used in its construction. As part of the effort to provide maximum durability with minimum weight, while at the same time ensuring economy in production, operation, and maintenance, manufacturers are continuously on the alert for new materials that can serve a specific purpose better, or cheaper, or both, than those traditionally employed. The aggregation of vehicles at the last Commercial Motor Show at Earls Court, London, visually demonstrated the general willingness of commercial vehicle manufacturers to develop new techniques to exploit the advantages offered by new materials or materials which in the past had been but indifferently appreciated or even ignored. Glass-fibre reinforced plastics and light alloys, for instance, were much more in evidence at this Show than they were at the immediately following Motor Show.

This seemingly progressive attitude is due in part to the fact that commercial vehicles are custom-built to a much greater extent than are private cars, and partly because tooling for commercial vehicles is generally more flexibly laid out for batch production in short runs and rapid changeover. Furthermore, taste and fashion exercise a much less powerful influence on commercial vehicle design than functional suitability and reliability. This is not to imply that commercial vehicle builders have little or no concern for the appearance of their productions. In many cases, by designing primarily for function, a large passenger or commercial vehicle has a more integrated and satisfying appearance than a rather over-stylized private car.

A material that in recent years has gained an increasingly wider acceptance, particularly on commercial vehicles, is expanded sheet metal. It is relatively inexpensive in first cost, easy to fabricate, versatile in application and has an inherently attractive appearance.

The main physical advantage possessed by expanded metal over other forms of metallic mesh is its homogeneous construction. There are no welds to fail under vibration or high temperature, and no interwoven strands to slip or fray, especially along cut edges. The material is readily worked, and can be sheared on a guillotine or, even in heavy gauge, by hand snips. Complex shapes can be stamped out in a press, like any other form of sheet metal, and double curvature can be applied with quite low-powered tools.

Aesthetically, the great attraction of expanded metal lies in its surface texture, the character of which varies with the direction from which it is viewed and from which it is illuminated. It is thus particularly suitable for all kinds of screening applications. The wide range of gauges and mesh sizes available facilitates the selection of material of a pattern well suited for a specific duty.

Protective grilles

Probably the most obvious application of expanded metals is for radiator grilles, for which it has the special advantage that it offers the minimum restriction to the flow of cooling air. Except in the very finest meshes, the proportion of open area to total area is well over half, and rises in some sizes to over 80 per cent. In addition to protecting the radiator from damage by collision or from stones thrown up by traffic, it effectively and attractively screens from view the rather unprepossessing gilled tubes of the radiator block. A good example of its use for this purpose is illustrated in Fig. 1, which shows the front end of the new Routemaster double-decker bus designed by London Transport, with mechanical units by A.E.C. Ltd., Southall, and body manufactured by Park Royal Vehicles Ltd., London, N.W.10. A great deal of attention has been paid to the overall appearance of this vehicle, which will for many years be a familiar feature of the London scene. In the radiator grille, a simple but attractive effect has been achieved by using expanded metal of fairly fine mesh which blends well with the general front-end treatment. The two smaller grilles at the bottom of the front wings are designed to admit cooling air to the brakes, which are otherwise shrouded by the wings. An open-mesh material is selected for this position to offer the minimum resistance to the air flow.

Fig. 1. Routemaster bus designed by London Transport, with mechanical units by A.E.C. and body by Park Royal. Fine mesh expanded metal is used for the radiator grille and material of coarser mesh for the brake cooling inlets in the wings

Heavy duty applications

That expanded metal is not merely a decorative grille material for vehicles operated on well-surfaced roads is indicated by Fig. 2. This shows the underfloor radiator grille installation of the Daimler Freeline coach chassis, which is designed for trouble-free operation in overseas territories. Vehicles of this type are being supplied to Israel and to Colonial markets where the road conditions vary from moderate to very rough indeed. This radiator is placed low down behind the front axle of the coach, where it is the target for stones thrown up by the front wheels. The stout expanded metal shield affords complete protection to the gilled tubes from debris large enough to do any damage yet does not materially impede air flow.

Even more severe conditions prevail in the case of vehicles like the Foden 9·8 cubic yard dump truck shown in Fig. 3. To protect the radiator from lumps of rock falling during loading, or while awaiting loading, a free-standing expanded metal grille is provided. A screen of this type, supported in a mild steel frame, has excellent resilient properties which enable it to resist heavy impacts effectively. Expanded metal is nowadays almost a standard grille material. Even when plated bars are used for the sake of appearance, an inner, unseen screen of expanded metal frequently provides the real protection.

Variety of forms

One of the most useful features of Expamet (the trade name of expanded sheet materials manufactured by The Expanded Metal Co. Ltd., Burwood House, Caxton Street, London, S.W.1) is the variety of different forms and materials in which it is made. In the applications described above, mild steel is the obvious choice for strength and economy. In this form, Expamet is available in gauges from roughly 0·025 in to 0·125 in, and with mesh openings from 0·125 in long to 2·75 in long. The shorter dimension of the mesh varies from about one third to one half of the length of opening, according to the size.

In considering the gauge of the material it should be remembered that, in expanding the sheet, the strands are turned almost edge-on, so that the effective thickness is more nearly that of the pitch of the slits, and is always considerably greater than the nominal gauge. The wide range of meshes available means that the most suitable one can be chosen for a particular application, having regard to the appearance, strength and the matter to be intercepted.

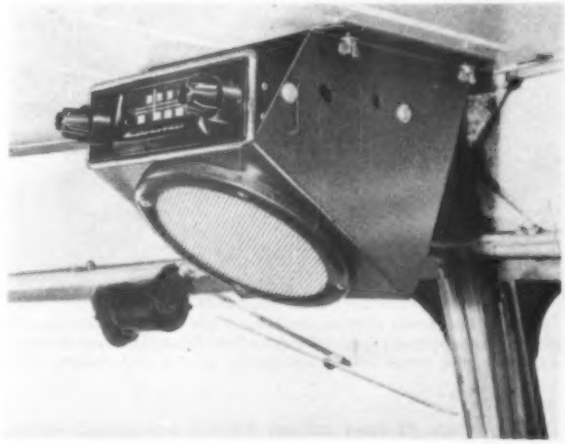


Fig. 4. Radiomobile commercial vehicle radio, with expanded aluminium grille over the loudspeaker. Maximum protection of the speaker unit is combined with minimum obstruction to sound. The finish is attractive and non-tarnishing

Aluminium mesh

Where economy in weight is more important than strength, expanded aluminium provides a neat and attractive effect, with the additional advantage that a wide range of lustrous, permanent colours can be incorporated by anodizing. This material is used almost universally for loudspeaker grilles, such as that on the Model 20X Radiomobile commercial set illustrated in Fig. 4. From being considered a few years ago as a luxury extra on private cars, the radio set is now widely recognized as a valuable piece of equipment on commercial vehicles, helping to relieve the tedium of long journeys on heavy transports. For loudspeaker grilles, expanded aluminium is the ideal material, as it combines full protection for the speaker diaphragm without obstructing the passage of sound. It is quite rigid and free from resonance.

Twelve anodized colours are available, and the range has recently been widened by the introduction of a number of variations from the normal diamond mesh. By altering the arrangement of the apertures, a number of attractive surface effects is produced, from simple chevrons to intricate "weave" patterns. These materials offer great possibilities for decorative grilles, not only for radio sets and heaters but also for interior or exterior trim, since it is non-rusting.

Fig. 2. The underfloor radiator of the Daimler Freeline coach chassis is protected from flying road stones by a stout screen of Expamet

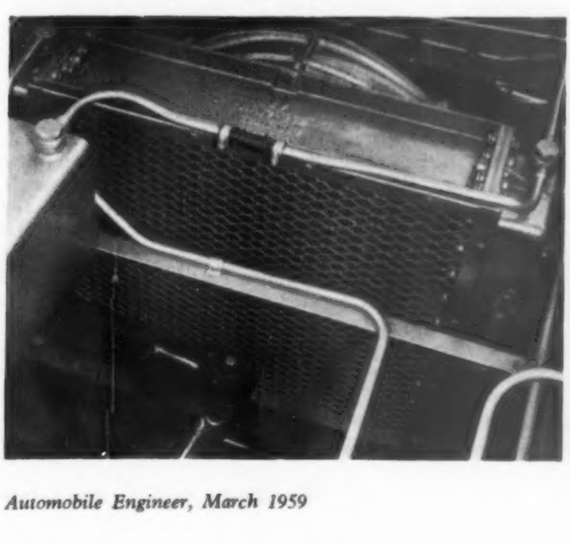
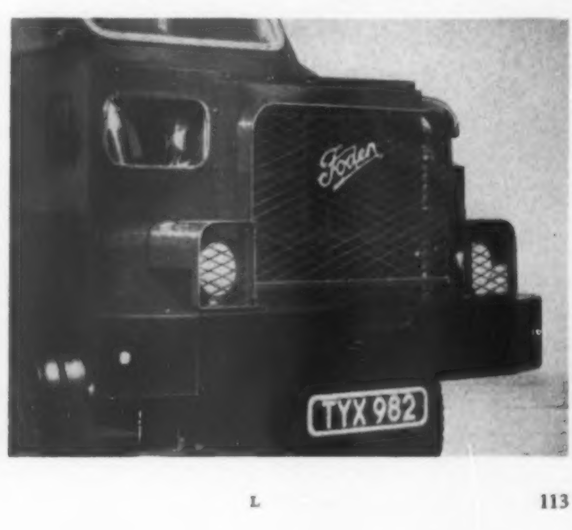


Fig. 3. Expanded metal grilles over the radiator and headlamps on this Foden dump truck withstand impact by heavy lumps of rock



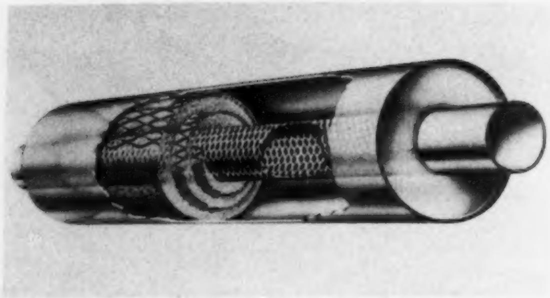


Fig. 5. In the Servais silencer, the exhaust gas pulses pass through the fine Expamet inner duct into the glass-fibre filled expansion chamber. Expansion and contraction of the duct produce a self-cleaning effect

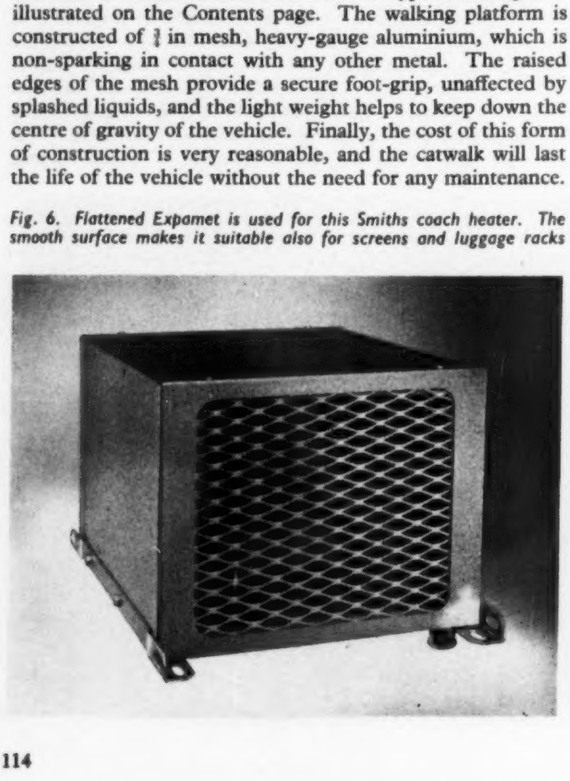
Tankers

The design of road tankers for oil, petrol and various chemicals is a highly specialized undertaking. Among the problems associated with such vehicles, the danger of fire is, perhaps, the most important. The vehicle is most vulnerable during filling and cleaning operations, when the manholes are open, and gaseous combustible mixtures are likely to escape to atmosphere. It is, therefore, essential to eliminate the possibility of sparks being generated, for example by tools or boot studs striking ferrous metals on the top of the tank.

For this reason, catwalks have in the past been constructed of timber slats. While this method ensured that no sparks could occur, timber is not entirely satisfactory for a number of reasons. Should the structure be splashed with oil or petrol it becomes slippery and dangerous. The durability of timber in this application is not very good, and if a small fire should occur, such a structure could well serve to propagate it, especially if soaked with petrol.

A complete answer to the problem is to use heavy-gauge expanded aluminium for the walk-ways. The firm of Darham Industries (London) Ltd., which specializes in the design and construction of road tankers of all types, has adopted this material as standard for catwalks. A typical example is illustrated on the Contents page. The walking platform is constructed of $\frac{3}{4}$ in mesh, heavy-gauge aluminium, which is non-sparking in contact with any other metal. The raised edges of the mesh provide a secure foot-grip, unaffected by splashed liquids, and the light weight helps to keep down the centre of gravity of the vehicle. Finally, the cost of this form of construction is very reasonable, and the catwalk will last the life of the vehicle without the need for any maintenance.

Fig. 6. Flattened Expamet is used for this Smiths coach heater. The smooth surface makes it suitable also for screens and luggage racks



Efficient silencers

The properties of expanded metal as an engineering material are fully and ingeniously exploited in one version of the so-called straight-through silencer. In the conventional baffle silencer, considerable back pressure may be set up, resulting in loss of efficiency. Generally, the baffle-type silencer is difficult, if not impossible, to repair should any of the baffles become loose, while the removal of carbon, which further reduces the efficiency of the engine, presents a problem. In the straight-through silencer, noise reduction is achieved by allowing the exhaust pulses to expand through apertures in the central gas tube into a surrounding chamber, from which they are dissipated back to the pipe at the intervening periods of low pressure.

Numerous forms of construction have been used, one of which is shown in Fig. 5. The central duct is welded from fine-mesh expanded steel strip and is quite rigid, yet allows the gases to pass freely into the surrounding expansion chamber. This chamber is filled with glass fibre, which has excellent sound-damping properties. The glass-fibre layer is supported and maintained at the required density by a sheet of open-mesh expanded metal which is laid in a spiral round the central duct. The inner end of the expanded metal spiral is welded to the duct, so that the assembly is secured.

The effect of the silencer is to reduce the pulsations to a substantially smooth flow at the outlet without creating any back pressure. In fact, it is claimed that the silencer offers less resistance to flow than a straight pipe of the same diameter as the inner duct, by virtue of the expansion allowed in the surrounding chamber.

The advantages of Expamet in this application are the combination of rigidity with unobstructed flow. Incidental advantages are the simplicity of construction and the absence of joints which might break down under heat, pressure, and vibration to cause mechanical noise and eventual blockage. An additional point claimed is that the inner duct, by constantly expanding and contracting as the engine heats up and cools down, is completely self-cleaning, any carbon formed being quickly shaken off and carried away.

Flattened Expamet

In some instances, the ridged surface of standard Expamet may prove an embarrassment. For applications such as screens, fences or guards likely to come in contact with clothing, a completely flat surface is preferable. This is provided by a special form of mesh, known as flattened Expamet. It is produced simply by rolling the sheet, after expansion, to produce a perfectly smooth diamond mesh like that shown in Fig. 6, which illustrates a Smiths coach heater. The case is constructed of sheet metal, the grille being flush with the front of the shell, to which it fits more closely than the normal woven mesh. This flattened material is also well suited for luggage racks, where the smooth surface will not damage suitcases or articles of clothing.

Versatility in application

The examples described have been taken at random from applications of Expamet on currently produced vehicles, and are by no means exhaustive. New uses are constantly being developed by the vehicle manufacturers. New demands from users in turn stimulate the production of new versions of Expamet. The range is continually being extended by the development not only of new patterns, but of the materials from which it is made. An instance of this is the use of Stelvetite*, the P.V.C.-coated steel sheet produced by John Summers and Sons Ltd., of Shotton. The patterned plastic coating is so securely bonded to the steel sheet that it is undisturbed by the expansion operation. However, since the process leaves the cut metal edges exposed, expanded panels in this material are suitable only for interior trim.

*"*Automobile Engineer*", *January* 1958.

The Wickman Impregnator

Portable Unit for Applying a Wear-resistant Layer of Sintered Carbide to Cutting Tools, Dies and Machine Components

WITH a background of experience in the manufacture of spark erosion machines and equipment extending over nearly a decade, Wickman Ltd. has developed a further product. Known as the Wickman Impregnator, the new unit is designed to apply a layer of sintered carbide material to the surface of tools, dies, or components where enhanced resistance to wear is required. In general terms, the principle employed is a reversal of the spark erosion process. Experience so far gained has been mainly in the field of metal-working and wood-working tools. However, any metal component on which problems of wear are encountered represents a potential application.

The equipment is a self-contained, portable unit, comprising a case housing all the electrical components and control apparatus, a hand applicator, and a supply of carbide electrodes. Three different patterns of electrodes are available; of chamfered-end, screwdriver-end, and scriber-point types.

Electrical input is by way of a 3-core flexible lead which can be plugged into any 200-250 volt, 5 amp, single phase, supply socket. Current consumption is 400-500 watts. A selector switch on the main case provides control of depth of the applied layer. "Coarse" position will give rapid coverage but a coarse surface; "fine" setting will give a better surface but require more time in application.

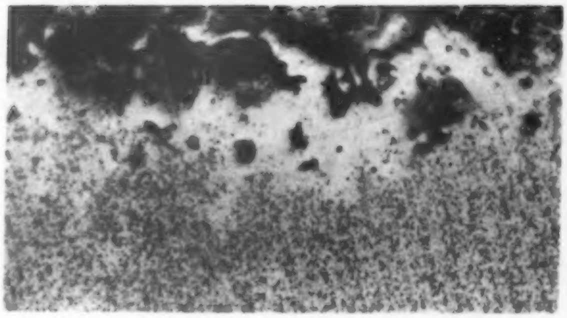
Carbide applied to the surface of the workpiece is detached from the electrode by a localized sparking action. It follows that the treated area will not uniformly receive the maximum depth possible with a specific setting. It is recommended, therefore, that the treated surface should not be ground or lapped.

The carbide is not merely deposited on the work but penetrates the surface and builds up on it, as may be seen in the transition zone of the micro-section illustrated. On the coarse setting the thickness of the layer is of the order of 0·003 in but on the fine setting it is about 0·0005 in.

In appearance the treated surface is relatively rough and dull. Tests show that substantial advantages are obtained without attempting to improve the surface. For example, a H.S.S. extrusion die for aluminium was treated. Notwithstanding the apparant roughness of the treated surface, the finish on the extruded work was quite acceptable. The treated die produced more than 120 billets before requiring extraction for the removal of pick-up. In its untreated state it had to be cleaned after each five billets.

Only that area of a tool which, in the untreated state, suffers the highest rate of wear is given treatment. Including carbide, labour, and overheads at 250 per cent, the cost of treating a square inch of flat surface is from 2s. 0d. to 2s. 6d. The time expended, on the fine setting used for cutting tools, is about 5 min. Individual electrodes, costing from 10s. 0d. to 15s. 0d. each will treat from 70 to 80 square inches of surface.

Records of the comparative performance of untreated and treated tools all show substantial improvement, whether expressed in the number of workpieces between regrinds, the period of service between regrinds, or the rate of wear of the tool while machining a specific batch of workpieces.



Micro-section of a treated tool surface, showing penetration and build-up of carbide layer

Treating the top land of a lathe tool to prevent cratering under the action of chip flow

The complete unit is portable and takes its power from any 200-250 volt, 5 amp, single phase supply socket

Grinding Crankshaft Fillet Radii

A New Peripheral and Radius Dressing Fixture Introduced by Engineering Diamonds Ltd.

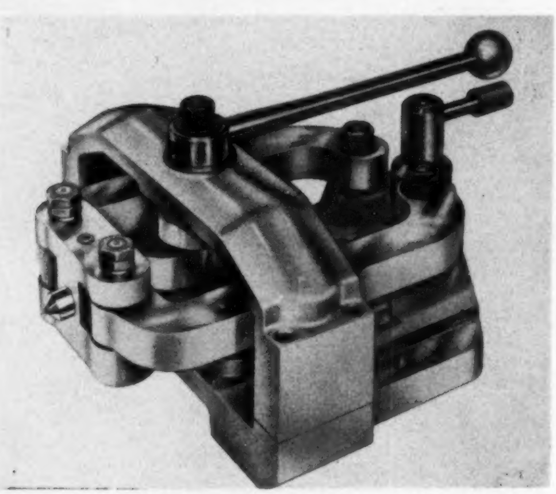
CRANKSHAFT journals and crankpins are formed with fillet radii aimed at providing strength at their junctions with the crankshaft webs. It has been demonstrated that a crankshaft can be fractured under load, and that in practically all cases the fracture takes place at the apparent blending plane between the fillet radius and the bearing diameter. Investigation has traced such breakages to faulty blending or malformation of the radius.

The majority of bearing forms, comprising plain diameter with one or two fillet radii, are ground by the plunge method. It is necessary, therefore, that the grinding wheel should have a form complementary to the bearing, that is, a straight periphery with one or both corners radiused. For about half a century such radii on the grinding wheel have been dressed free-hand by the operator who, even though he may be ambidextrous, cannot be expected to guarantee the consistency of form throughout a working shift. In fact, it may be said that the basic difference between cylindrical grinding machine operators and crankshaft grinder operators is the ability of the latter to dress radii effectively. Some manufacturers have found a shortage of suitable labour, because otherwise satisfactory applicants have lacked this specific skill.

In view of the demand for engines of a more favourable power : weight ratio, and the consequent higher stressing of individual components, errors of form previously accepted cannot now be tolerated. The problem of the production of crankshaft fillets has been the subject of investigation and development for some years. Partial solutions have been found by the adaptation of profile copying, but this method requires diamond tools which are expensive to maintain. In fact, two or three diamond tools are used simultaneously, making adjustment to arrive at a good form a long process.

Engineering Diamonds Limited, 26 Warwick Row, Coventry, after several years of development, has now produced and proved under normal production conditions, a device for dressing the periphery and the respective corner radii of the grinding wheel with a single natural diamond, simply and quickly. Known as the Endia peripheral and radius dressing fixture, Model PRD.650, the device consists of a patented arrangement of pivoted links for transferring rotary motion from three base pivot points to cause the diamond to rotate round a theoretical pivot. This is necessary in view of the large diameter grinding wheel normally used, where conventional "cradle" or "gooseneck" diamond carriers would foul the wheel and be ground away.

The Endia single-diamond, peripheral and radius dressing fixture



A line illustration shows the linkage arrangement in two positions for dressing respectively the periphery of the wheel and one of the radii. The use of three base pivots gives greater lateral and vertical security in all positions, as compared to the usual parallel-motion, two-pivot mechanism. This additional support, in conjunction with the double trunnion connections between the side links and the diamond-carrying member, gives more than sufficient rigidity for the diamond to be used for normal peripheral dressing.

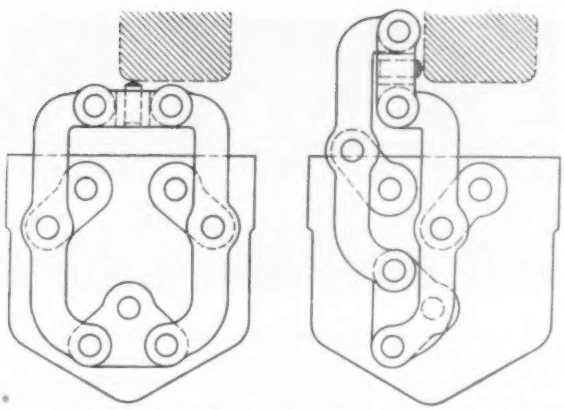
The fixture incorporates a mechanism enabling the diamond to be held and locked centrally during peripheral dressing, and to be selectively released to move through a controlled 90 degrees of arc at either side of the wheel. By positioning the shorter selector handle in line with the pivoting handle, so that the selector segment on the underside of the rear base pivot is engaged on a stop pillar on the base, all pivots are prevented from rotation and cannot be accidentally moved during the first dressing stage. For dressing radii, the selector is moved through 90 degrees to the left or right. This frees the pivots for rotation in the selected direction and permits a radial movement of 90 degrees which is positively limited by fixed stops. It is impossible to "dig into" the previously dressed periphery or into the side of the wheel.

Positioning of the single diamond to produce a particular form is merely a matter of adjusting the distance that the diamond tip projects from the front face of the diamond-carrying member. This face forms a datum of known distance from the theoretical pivot point, so that provision of a simple step gauge enables the required projection to be attained and maintained with ease. For short run work, slip gauges can be used. It should be noted that wear of the diamond in use has the effect merely of producing a slightly larger radius, still of perfect form, and this is corrected by advancing the diamond up to the gauge height. With profile copying methods, diamond wear results in malformation and necessitates replacement of the tools.

Model PRD.650 fixture is designed for radii of up to 0·500 in. Since the straight dressing of the wheel is carried out by using the normal machine traverse and wheel in-feed, there is no limit on wheel width or wheel diameter. Crankshaft bearings of any diameter and length, therefore, with radii less than 0·500 in can be form-ground with wheels dressed by this equipment.

Method of mounting

An assembly is illustrated showing the dressing fixture mounted in a base, Model PG.651. Extending from the sides of this base are bars dimensioned to give the same overall length and end diameters as the crankshaft being machined, so that the whole unit is interchangeable with the component. The bars can carry a flange having any desired location holes or faces, as used for positioning the actual component in the cradles or centres of the machine. In the absence of such holes or faces, the bars can be fitted with a spirit level positioned to give the angular tip or displacement



Diagrams showing three-pivot linkage arrangement. Left, locked for peripheral dressing. Right, end of pivotal movement for radius dressing

necessary to ensure the correct alignment with the wheel in relationship to the throw of the crankshaft.

Such extension bars can be replaced by alternative bars at any time in order to use the equipment for other crankshafts. The assembly can be used on the machine with little or no disturbance of the steadies which may be on the table. Alternatively, the basic fixture can be mounted on any suitable support or auxiliary base attached to the table of the grinding machine, and auxiliary bases can be supplied.

Operation

1. With the fixture locked centrally, the periphery of the grinding wheel is dressed by normal table traverse and wheel in-feed. This ensures that the wheel edge is parallel to the table, thus guaranteeing a parallel bearing. After the last pass of the diamond, the in-feed hand wheel is read and noted, or set at zero.
2. The machine table is traversed to the left so that the diamond is clear of the wheel, and the diamond is pivoted to the extreme left position.
3. The machine table is then moved to the right until the diamond point is about 0·002 in from the side of the wheel, by sighting or by table stops. (On those machines having a "spark-splitting" movement of the wheel head, this movement can be used for finally reaching the 0·002 in gap.)
4. Next the wheel is backed away a little. Whilst swinging the pivoting handle repeatedly through its full arc of 90 degrees, the wheel is wound in again, in the usual dressing increments, until the in-feed reading applying to the peripheral dressing is reached. It is usually an advantage to work to minus 0·001 in on this reading so that the diamond finishes 0·001 in clear of the periphery of the wheel.
5. Lock pivots, traverse table to the right and repeat positioning and radius-dressing sequence.

There is an obvious advantage in enabling the operator to produce the correct wheel form without trial and error, but additionally, the simplicity of mounting, setting, and operation undoubtedly leads to less dressing time and more production time per shift.

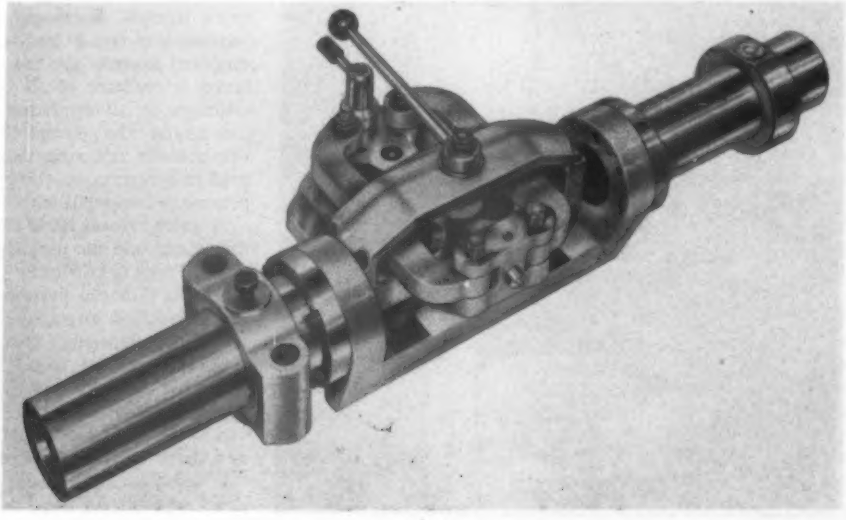
Since it is not unlikely that crankshafts will be more highly stressed in the future, the practice of rolling fillet radii after grinding to obtain greater strength may well become more generally accepted. The rollers cannot be applied with the pressure necessary to correct malformed radii, as under such conditions metal would flow to the extent of leaving an annular ridge at the blending plane. Consequently, in order to carry out this rolling process satisfactorily, it is essential to precede it by grinding true radius forms. In production runs, using this new Endia wheel-dressing equipment, it has been proved that the resulting radii are fully suitable for the fillet-rolling process.

Diamond tooling

The dressing fixture PRD.650 uses a single, natural diamond only and the makers, long-established manufacturers of diamond tools, recommend practically the same sizes and qualities of stones as previously used for normal wheel dressing. The only difference is that, as in all radius-dressing operations, the diamond point must be absolutely concentric in its holder. To ensure this the tool shanks are machined to size after the diamond is mounted, using optical means to centralize the point.

The initial tool used under normal production conditions, gave four weeks service before first resetting was necessary. During this period the loss of weight of the stone represented a negligible financial cost. The complete assembly is far lower in initial cost than profile copying devices, and is far more economical in diamond cost and dressing time. The equipment can be moved from one machine to another without the need for adjustment or dismantling. It can be changed to meet modifications made to the crankshaft, or to adapt it for use with other crankshafts, merely by replacement of the relatively inexpensive extension bars.

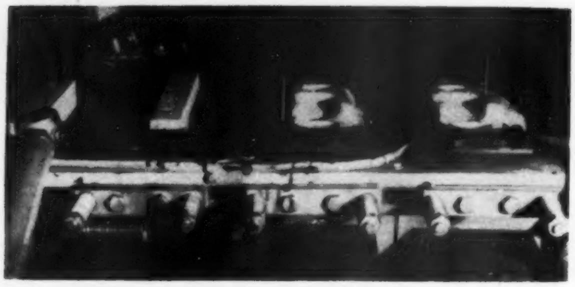
Dressing fixture assembled on a cradle mounting interchangeable with the component workpiece



New Plant and Tools

Recent Developments

in Production Equipment



THE world's first fully automatic, transfer-type forging press has been developed by the Erie Foundry Company, Erie, Pennsylvania, U.S.A. Designed for forging such components as connecting rods, gear blanks, stemmed pinions, ring gears, wheel hubs and track links, the 2,500-ton press can be provided with up to four forging and trimming stations. For more than a year it has been tested under production conditions forging a 4 in×10 in crawler track link, in customers' dies, from 1⅝ in×1⅝ in×8¼ in billets. Requiring a single attendant merely to monitor operation, production is at the rate of 1,200 links per hour. By comparison a steam hammer and a team of three men can forge about 275 links per hour and a manually fed mechanical press with two men—heater and operator—can produce about 350 per hour. The ability to trim as well as forge in the press cycle offers the possibility of further substantial economies by the elimination of trimming presses and their operators.

In designing and developing the press, the main problems were found to be those associated with the handling of billets and forgings at temperatures of from 2,000 to 2,400 deg F, and the overheating and consequent rapid wear of dies due to continuous operation at a high rate. The heating furnace is immediately to the left of the press and the hot billet is conveyed through a window in the press and a pusher mechanism positions it at the pick-up station. Here the grip fingers on the horizontal transfer bars grip the billet and move it to the second station for semi-forging.

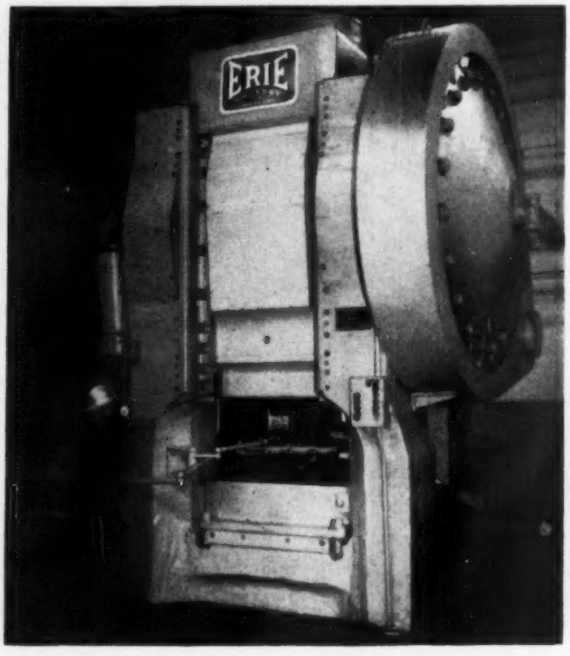
After the billet is placed, the transfer bars move outwardly—front and rear—and the press strokes. Knock-out pins, operated from a cam on the eccentric shaft, lift the forging and the second set of grip fingers carry it over to the third station for finish forging. Further knock-out pins lift it and the third set of grip fingers transfers it to a chute, down which it slides into a tote bin on the right.

A fourth station, for a trimming operation, can be incorporated if desired. The transfer mechanism is driven by chain from the eccentric shaft and the actuating linkage is arranged on the left, outside the die area. The press runs continuously at 40 strokes per minute, giving a potential production of 2,400 forgings per minute. At this rate, however, with so little time between strokes, die life would be seriously curtailed. Practical conditions for continuous operation are attained if a hot billet is fed in every second stroke, giving a production of 1,200 items per hour, as previously quoted.

Overall height of the 2,500-ton press illustrated is only 11 ft 3 in. This is accomplished by employing a Scotch yoke mechanism, thereby eliminating the usual pitman and ram pin. Other presses have been designed for capacities of from 1,000 to 8,000 tons. The British representative for Erie presses is Burton, Griffiths and Co. Ltd., Mackadown Lane, Kitts Green, Birmingham, 33.

(Above) Three-station transfer mechanism on Erie automatic press

(Below) Erie 2,500-ton, transfer-type forging press
Burton, Griffiths & Co. Ltd.



Plastic plating barrel

An immersible, hexagonal plating barrel recently introduced by Sonic Engineering and Equipment Ltd., 120-130 Parchmore Road, Thornton Heath, Surrey, is built of ½ in thick, abrasion-resistant Perspex assembled by means of nylon screws. Bearings and intermediate drive gears for rotating the barrel are of resin-laminated fabric and the insulated tie-rods are the only steel parts embodied. The barrel is resistant to all types of pre-cleaning and plating solutions at all operating temperatures and can be used throughout the entire cleaning and plating cycle, thus substantially reducing handling time. Since no cement is used in construction, the replacement of any part is a simple process as compared with conventional barrels.

A quick-release lid is fitted to the barrel for loading and unloading, and the perforations in the panels are arranged to suit the type of part to be plated. Partitions can be provided to enable different parts to be plated at the same time, and the suspension arrangements can be modified to suit individual requirements. Overall length of the standard model is 24 in, and the diameter across flats is 14½ in, accommodating process loads up to 90 lb. The hangers are rubber covered so that no deposit build-up can occur. Barrel units can be supplied individually, or with whatever types of tank and drive unit are required, for individual plating units or for complete sequential cleaning, plating, rinsing, and draining units for large scale production.

A Headlamp Deterioration Meter

A Portable Instrument for Indicating the Condition of Headlamps and Auxiliary Lamps

V. J. Jehu, M.Sc., A.Inst.P. and A. J. Fisher, B.Sc.*

HEADLAMP aiming equipment of the condenser lens type usually incorporates a photoelectric cell and meter to indicate beam intensity, and this gives some guidance as to the condition of the light unit. However, the maximum intensity of a beam is determined not only by the condition of the light unit but also by the type of beam it produces. Thus the maximum intensity of a wide beam will be lower than that of a narrow beam from units having the same size of reflector and the same filament power. A more reliable means of assessing the condition of a light unit is a measurement based on the total light emitted by the reflector, irrespective of the beam pattern; this method of measurement can be applied equally well to headlamps and to auxiliary lamps, the beam pattern and maximum intensity of which vary considerably from one type of lamp to another.

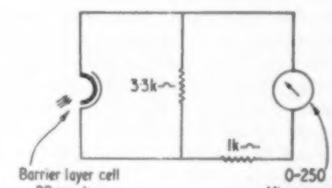
This article gives details of a simple meter designed on this principle, which is both portable and easy to use. The meter is a general purpose instrument that can be used by day or by night. It gives a more reliable indication of the condition of headlamps and auxiliary lamps than can be obtained from readings of the maximum intensities of the beams.

Essentially, the meter is a device that destroys the beam pattern of the lamp and enables the total light output of the lamp to be integrated. A general view of the instrument is shown in Fig. 1 and its constructional details are illustrated in Fig. 2. It consists of a box, 4 in deep, with a circular hole covered with diffusing glass in one side. Opposite the aperture, an opal plate is mounted, and the remaining two sides and floor of the box are painted with a matt white finish. A small photoelectric cell is mounted immediately behind the aperture; it faces into the box and is connected to a microammeter, which is visible through a hole in the top of the box. The meter is mounted in a Perspex block so that it can be read at night by the light from the lamp under test. A tube 5 in long is fitted to the aperture, which can be covered with a slider when the meter is not in use.

The aperture size has been selected to fit modern headlamps, most of which are nominally 7 in diameter. Fitting closely to the rim of the headlamp under test, the tube performs two functions: it screens the meter from external light so that the instrument can be used by day or night, and also, by ensuring that the bulb is some distance from the diffuser glass, it minimizes the error due to the effect of light projected forwards directly from unshielded filaments. Most headlamp bulbs are unshielded or only partly shielded, so the light that enters the meter from headlamps is generally made up of two parts: light from the reflector, which forms the beam pattern, and light projected forwards directly from the filament, which does not contribute to the beam pattern of the lamp.

If the lamp is held close to the meter, an appreciable part of the light entering the meter comes directly from the filament, even when the lamp reflector is in good condition. The proportion of the total light contributed by the filament increases as the reflector tarnishes, and this tends to mask the effect produced by reflector deterioration. As the meter is moved away from the lamp, the effect of direct filament light becomes less. Measurements made with shielded and unshielded bulbs in a block-lens light unit showed that when the lamp was 4 in from the diffuser glass of the meter (5 in from the rim of the light unit) the contribution of the filament light was small enough to be ignored.

Fig. 3. The circuit diagram of the headlamp deterioration meter



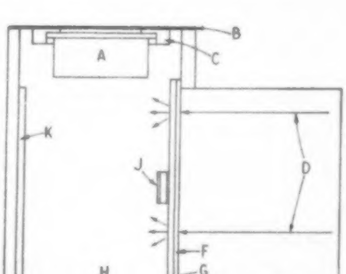


Fig. 2. Cross-section of the headlamp meter showing the layout of its principal components

A microammeter; B cover plate; C Perspex block; D headlamp beam; E stand-off tube; F slider; G diffuser; H matt white surface; J photoelectric cell, facing into box; K opal screen

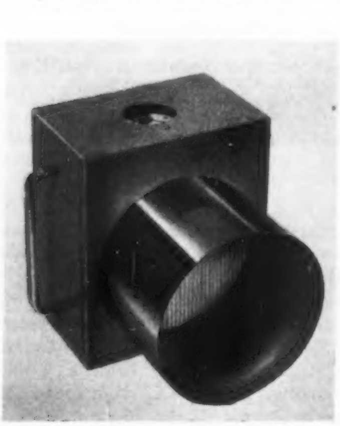


Fig. 1. The headlamp meter is simple, portable and can be used easily either by day or by night

The circuit diagram is illustrated in Fig. 3. Two resistors are incorporated, and their values have been chosen to fulfil the following two requirements: almost full-scale deflection for a standard block-lens light unit in good condition, and a scale becoming less sensitive with increasing deflection of the meter. The latter requirement is necessary so that all lamps in good condition register about the same

*Road Research Laboratory, Dept. of Scientific and Industrial Research.

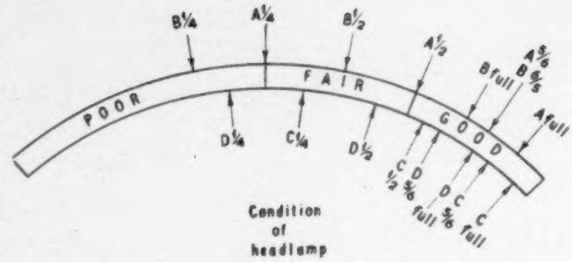
deflection, regardless of filament wattage or beam pattern. The choice of meter and photoelectric cell is a compromise between sensitivity and cost: a small cell 20 mm diameter, and a 0-250 microammeter are used.

In Fig. 4, the scale of the recording meter is shown, together with readings obtained from the driving beams of four lamps having either different beam distributions or different filament wattages. The scale is divided into three sections labelled "poor", "fair" and "good", the boundaries of the sections being determined by the performance of the common 7 in block-lens light unit. Thus, the division between "good" and "fair" corresponds to the reading obtained from a new unit when the voltage was adjusted to give one-half the intensity that it gave at 12·8 volts, and that between "fair" and "poor" corresponds to the reading when the voltage was adjusted to give one-quarter of the intensity at 12·8 volts. This voltage is more realistic than the nominal 12 volts as a basis for the measurements, since it is more closely representative of the conditions obtained when the vehicle dynamo charges the battery. With 6 volt systems, however, the voltage at the lamps is usually close to the nominal voltage when the battery is charging, and for this reason the fractional readings shown in the appropriate part of the table in Fig. 4 relate to 6 volts.

From Fig. 4 it can be seen that all the lamps in good condition register as such on the scale, but that errors due to variation in wattage and extreme variation in beam pattern have not been completely eliminated. The effect is to allow less deterioration of the lower wattage and low intensity lamps; this, however, may not be a disadvantage.

In use, the slider is removed and the meter held in front of the lamp under test, so that the rim of the tube rests against the lamp housing. Lamps smaller than 7 in diameter should be centred relative to the axis of the tube but not pushed in. Headlamps should be tested when set to give the driving beam.

If a low reading is obtained with the vehicle engine stopped, this may be due to a discharged battery rather than to a poor lamp. As a check, the test should be repeated with the engine running sufficiently fast to charge the battery. If a low reading is still obtained, then there is a lighting fault. The fault may be due to a tarnished reflector, bulb blackening, dirt and condensation in the light unit, faulty wiring, or a combination of these.



Lamp code	Lamp type	Beam distribution and max. intensity	Check points on meter scale
A	Headlamp 12 V, 42 W/36 W	Driving beam 40,000 cds	Reading at: 12·8 V (Full intensity) 12 V (5/6 intensity at 12·8 V) 10·3 V (½ intensity at 12·8 V) 8·4 V (¼ intensity at 12·8 V)
B	Headlamp 6 V, 30 W/24 W	Driving beam 30,000 cds	Reading at: 6·4 V (6/5 intensity at 6 V) 6 V (Full intensity) 4·8 V (½ intensity at 6 V) 3·9 V (¼ intensity at 6 V)
C	Auxiliary driving lamp 12 V, 45 W (yellow)	Pencil beam 80,000 cds	As A
D	Fog lamp 12 V, 45 W (yellow)	Wide angle 4,000 cds	As A

Fig. 4. Layout of scale, and readings obtained from a range of lamps

Older lamps in good condition which are not pre-focused may register a favourable reading on the meter although in fact their performance on the road is unsatisfactory. This occurs when the lamps are incorrectly focused, a fault that becomes apparent when the aim of the lamps is checked.

The work that has been described was carried out as part of the programme of the Road Research Board of the Department of Scientific and Industrial Research, and the article is published by permission of the Director of Road Research.

Noral 28S

ALTHOUGH all aluminium alloys can be successfully machined, provided the correct techniques are employed, the characteristics of some are such that their use in automatic machines presents difficulties. For example, the swarf may be long and unbroken, or build-up of metal on the cutting edge of the tool may be experienced. Noral 28S has been developed specifically as a machining alloy and is said to exhibit none of these disadvantages. In fact, its properties, so far as machining is concerned, compare well with those of free-cutting brass, while its cost, volume for volume, is little more than half as high. Its density is only about one-third of that of either brass or steel: in other words, approximately three times as many components can be produced from Noral 28S as from the same weight of brass or steel.

In respect of corrosion resistance, Noral 28S compares favourably with the high-strength, heat-treated, copper-bearing aluminium alloys. If a greater degree of corrosion resistance is required, it can be anodically treated. For bars of ½ to 2 in diameter its 0·1 per cent tensile proof stress is 16 ton/in^2, and its ultimate tensile strength is 20 ton/in^2, while it exhibits an elongation of 8 per cent, as tested on the length of 2 in. These are guaranteed mechanical properties, and the actual properties likely to be experienced in practice are probably about 15 per cent higher than this. Further details can be obtained from Northern Aluminium Company Ltd., Bush House, Aldwych, London, W.C.2.

Road Vehicle Equipment

AN ILLUSTRATED booklet has recently been published covering Clayton Dewandre and Bendix-Westinghouse equipment for road vehicles. Many well known components are described, and among the latest developments are levelling valves for air suspension systems, and a Dual Brake Valve, which has been evolved to divide the air pressure system into two separate parts, as a safety measure. Other components of air pressure braking systems for prime movers and trailers are described, as well as air-hydraulic and vacuum systems. The booklet also covers gear shift servos, two-speed axle control units, pneumatic valves and pressure indicators, power assisted steering units, air compressors and exhausters, trailer couplings, the Clayton-Oetiker exhaust brake, an automatic chassis lubricator and a range of heaters. Copies of the booklet can be obtained from the Clayton Dewandre Co. Ltd., whose address is Titanic Works, Lincoln.

CURRENT PATENTS

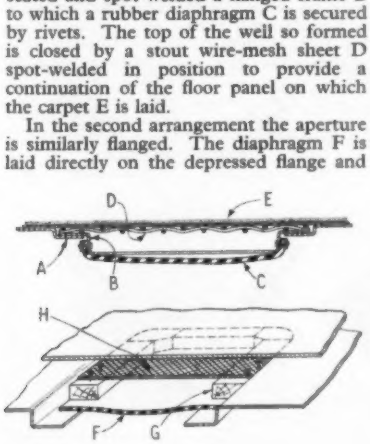
A REVIEW OF RECENT AUTOMOBILE SPECIFICATIONS

Prevention of body boom

Body booms are noises of low frequency which are propagated by flat areas of a body, especially on relatively large cars. A particular source of boom is the floor panel of a large vehicle, where the propeller shaft lies below the plane of the floor and no shaft tunnel, which would have a stiffening effect, needs to be provided. The remedy proposed is to form one or more apertures in the panel, each covered by a sheet of perforate material and closed by a spaced, non-porous, flexible diaphragm.

Two examples are shown. In the first the aperture is formed with a depressed peripheral flange A. On this flange is seated and spot-welded a flanged frame B to which a rubber diaphragm C is secured by rivets. The top of the well so formed is closed by a stout wire-mesh sheet D spot-welded in position to provide a continuation of the floor panel on which the carpet E is laid.

In the second arrangement the aperture is similarly flanged. The diaphragm F is laid directly on the depressed flange and



No. 797596

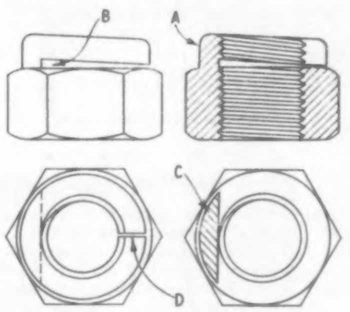
secured by wooden clamping strips G. On these strips is supported the perforate sheet H.

By its flexibility and non-resonant nature the diaphragm absorbs instead of reflects air pressure waves. *Patent No.* 797596. *Rolls-Royce Ltd.*

Improved stiff-nut

In recent years vigorous tests have been conducted on so-called stiff-nuts and more stringent standards have been established. There is a trend towards a unified thread system and also standardized dimensions. The object of this invention is to provide a nut of this general class that is suited to current requirements and standards.

As illustrated, the nut comprises a hexagon body having a cylindrical extension A at one end. This extension is slotted at B by means of a saw-cut, in a plane at right angles to the axis of the nut, extending across the bore to the major diameter of the screw thread and leaving a substantial buttress C. A second slot at D, in a plane containing the nut axis, forms the extension into two arcuate wings supported by the buttress C. These wings are then deformed by pressing them towards the nut body. It will be noted that whether the nut is screwed on or



No. 795203

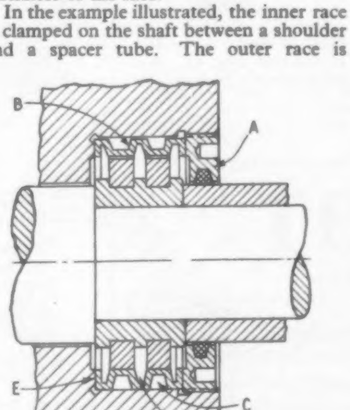
screwed off a threaded stem, one wing is of a "leading" type and the other of a "trailing" type.

In torsion tests for stiff-nuts, the nut is screwed on and off a standard stem a specified number of times. In tolerance tests, a nut that has been strained on a stem of maximum diameter must subsequently retain an adequate grip on a stem of minimum diameter. It has been found that nuts made according to the invention consistently give better test load figures than earlier types of nuts in this class. This permits more economic manufacture as somewhat greater tolerance can be allowed and less extensive inspection is required. *Patent No.* 795203. *Guest Keen and Nettlefolds (Midlands) Ltd.*

Adjustable roller bearing

Cylindrical roller bearings are known in which roller clearance is adjusted by expanding the inner race on a conical spindle or sleeve. The construction is relatively costly and bulky and some fitting may be required to align the races after adjustment. This invention is characterized by the provision of one race, generally the outer race, which is formed with inner and outer grooves. The intervening wall portions are deformable under axial pressure to increase the radial thickness of the race.

In the example illustrated, the inner race is clamped on the shaft between a shoulder and a spacer tube. The outer race is



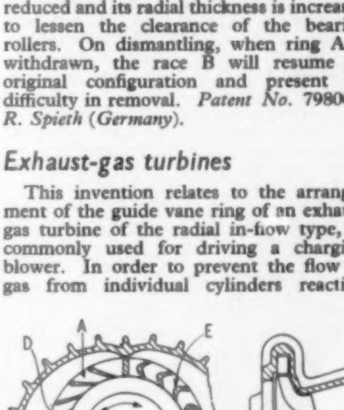
No. 798000

located in a casing bore and is seated by a threaded ring A. Outer race B, with external grooves C, internal grooves D and end flanges E, in the upper half of the drawing is shown as axially unstressed. In that condition the bearing has excessive clearance, as indicated.

When ring A is screwed farther into the casing, as shown in the lower half of the drawing, the axial length of race B is reduced and its radial thickness is increased to lessen the clearance of the bearing rollers. On dismantling, when ring A is withdrawn, the race B will resume its original configuration and present no difficulty in removal. *Patent No.* 798000. *R. Spieth (Germany).*

Exhaust-gas turbines

This invention relates to the arrangement of the guide vane ring of an exhaust gas turbine of the radial in-flow type, as commonly used for driving a charging blower. In order to prevent the flow of gas from individual cylinders reacting



No. 797780

adversely upon each other in the supply duct, or upon the scavenging of other cylinders, it is customary to feed the turbine by way of two ducts each receiving from a plurality of cylinders. Usually these ducts enter the distributor casing at points on the periphery spaced at 180 deg.

In this arrangement the ducts run parallel to each other and join the casing in a plane perpendicular to the axis of rotation and symmetrically in a plane containing the axis of rotation, each duct supplying one half of the guide vane ring A. In the casing, duct B is continued to embrace half of the ring in a clockwise direction and duct C the other half in the opposite direction. Guide vanes D in the half fed by duct B have the conventional form with entry angle α_1, and emergence angle α_2. The deflection angle is less than 90 deg.

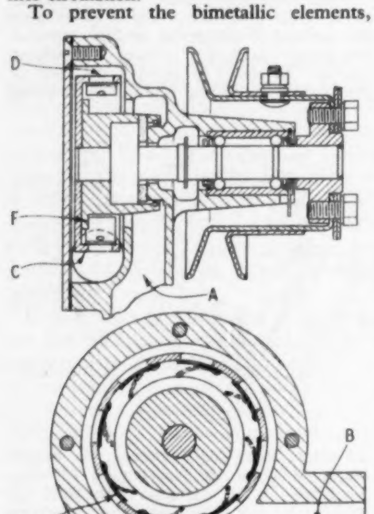
If conventional vanes with a similar emergence angle α_2 were provided for duct C, the deflection angle would be much greater than 90 deg. Accordingly, to obtain a similar entry angle, the vanes E are of the "hook" or "crescent" type, as shown. With this arrangement small radii of curvature of the ducts, with resulting high frictional and bend losses, can be avoided. A high efficiency can be attained without occupying undue space and incurring excessive weight. *Patent No.* 797780. *Daimler-Benz A. G. (Germany).*

Thermo-responsive coolant pump

With this pump the circulation of coolant is directly controlled by means of bimetallic vanes on the impeller, instead of by the familiar thermostatic by-pass valve. When starting from cold or when operating under extremely cold conditions, therefore, engine power is not wastefully absorbed in pumping coolant around a by-pass circuit. Between fully opened and fully closed positions the vanes will assume positions giving intermediate pumping rates.

The pump casing has an axial inlet A and a tangential outlet B, and the usual pump spindle assembly carries a fabricated, adjustable-flange pulley. A cup-shaped impeller C, secured to a hub on the terminal end of the spindle, has a plurality of apertures D in the peripheral rim, and each aperture is controlled by a bimetallic element E. Under low temperature conditions the elements D, riveted to the impeller, close the apertures and there is no pumping action. As the temperature of the coolant rises, however, the elements deflect to open the apertures and serve as vanes, and the pump discharges coolant into circulation.

To prevent the bimetallic elements,



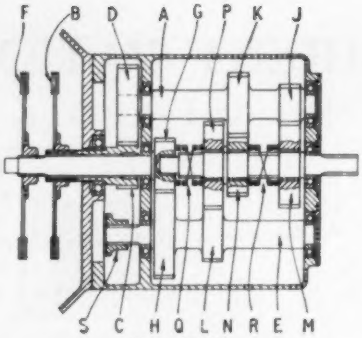
No. 794539

when functioning as impeller vanes, being deformed by fluid pressure at high rotational speeds to beyond their elastic limit, their deflection is limited. A flange F on the impeller hub provides a positive stop, as indicated in the sectional view. *Patent No.* 794539. *Thompson Products Inc.* (*U.S.A.*)

Two-layshaft gearbox

This gearbox having two independent clutches transmitting the drive through respective layshafts is particularly suitable for automatic control by, for instance, speed-responsive means with, preferably, an overriding manual control. It has two alternative power paths and it is possible to preselect a gear ratio in one whilst the drive is being transmitted through the other. For clarity, all the shafts are shown in one plane in the diagram but in practice the layshafts will not be located at 180 deg about the mainshaft.

Layshaft A receives the drive from clutch B through a hollow shaft and gears



No. 795260

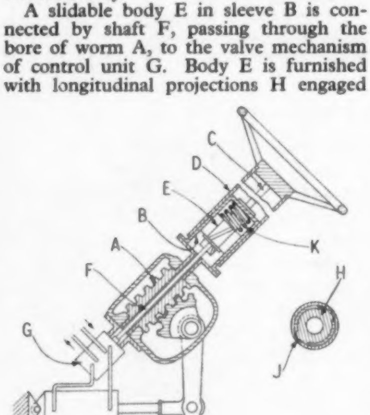
C and D. Similarly, layshaft E is driven from clutch F through gears G and H. The clutches are engageable alternatively. Layshaft A has fast with it the first-speed pinion J and third-speed wheel K while layshaft E has fast with it the second-speed pinion L. These three gears are in constant mesh with gears M, N and P respectively, all freely rotatable on the mainshaft. Slidably splined on the mainshaft are double-ended, toothed clutches Q and R, each furnished with a suitable synchronizing mechanism.

In first speed, gear M is coupled to the mainshaft and clutch B is engaged, and for second speed, gear P is coupled to the mainshaft and clutch F is engaged. Gear N is coupled to the mainshaft and the drive is through clutch B for third speed, and a direct fourth speed is obtained by coupling gear G to the mainshaft and engaging the drive through clutch F. For reverse, pinion S on layshaft E is moved on its splines to engage gear D on layshaft A and one of two ratios is available by selectively connecting either of gears M or N to the mainshaft. The drive is engaged by clutch F. *Patent No.* 795260. *David Brown and Sons* (*Huddersfield*) *Ltd.*

Power steering arrangement

In this design a torsionally elastic member is deformed by the applied steering force to influence the valves controlling the flow of pressure fluid to the servo piston. Worm A is rigidly connected to sleeve B and the steering wheel is connected to sleeve B by the torsion shaft C. A torsionally resistant tube D secured to the hub of the steering wheel encloses shaft C and sleeve B concentrically.

A slidable body E in sleeve B is connected by shaft F, passing through the bore of worm A, to the valve mechanism of control unit G. Body E is furnished with longitudinal projections H engaged



No. 797703

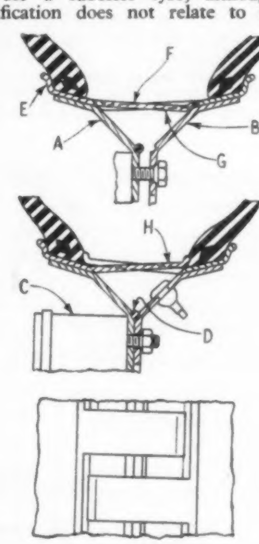
in slots in sleeve B and carrying helical splines J co-operating with helical slots in the lower end of tube D. A spring K and a spring (not shown) in the control unit, which is stressed in opposition, tend to keep body E zeroed when the vehicle is travelling straight ahead.

When steering effort is applied there is relative movement between tube D and sleeve B which is translated by the helical splines into longitudinal movement of shaft F, effecting displacement of the valve mechanism of the control unit. *Patent No.* 797703. *Adolph Saurer Ltd.* (*Switzerland*).

Bead-locking wheel rim

Against the contingency of sudden deflation, it is desirable that there should be no danger of the tyre being rolled off the rim. It may be of great convenience if a car can be driven slowly on a flat tyre. In the case of military vehicles, the ability to continue movement may be more important than any other factor. A rim constructed in accordance with this invention facilitates tyre and rim assembly, and on assembly provides automatically a positive bead lock.

The diagram refers to a symmetrical rim for a tubeless tyre, although the specification does not relate to specific



No. 797782

types. Essentially the rim consists of two parts A and B which, in all major respects, are identical. Part A is welded or bolted to brake drum C and part B is assembled with part A by means of a series of studs and nuts. A ring D of rubber or the like seals the junction.

To each of these parts is welded or brazed, in pressure-tight relationship, a separately formed, flanged bead seat E. At its inner circumferential edge, seat E is provided with a plurality of axially extending, circumferentially spaced fingers F having outwardly turned terminal flanges. It is suggested that the fingers have a width of the order of ½ in and the intervening spaces a width of 1½ in to 2 in.

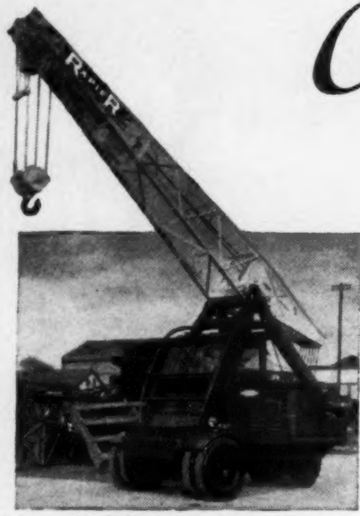
The fingers are stiffly resilient, but capable of radial deflection, and normally assume the position shown at G, when partially assembled. Further movement of part B to final assembly with part A will cause the interengaged fingers to ride up and on to the bead seats, as at H, and finally to forcibly engage the tyre beads. *Patent No.* 797782. *Firestone Tire and Rubber Co.* (*U.S.A.*)

WIN THE BATTLE OF THE BURR..

.. BY USING **Morrisflex** *Hammond*

BUILT UNDER LICENCE FROM
HAMMOND MACHINERY BUILDERS INC. U.S.A.

B. O. MORRIS LTD. · BRITON ROAD · COVENTRY
Telephone: 53333 (PBX) Telegrams: MORISFLEX, COVENTRY.



By courtesy of British Transport Commission

Cylinder wear is inexcusable

Specify—CROMARD

REGISTERED TRADE MARK

A "RAPIER" 7 Fast Standard Mobile Crane with "Perkins" P6 engine.

Ransomes & Rapier Ltd., by arrangement with F. Perkins Ltd., supply "Cromard" liners in the engines of these "RAPIER" Cranes as specified by the BRITISH TRANSPORT COMMISSION

ALSO MAKERS OF THE LAYSTALL FAMOUS CRANKSHAFTS

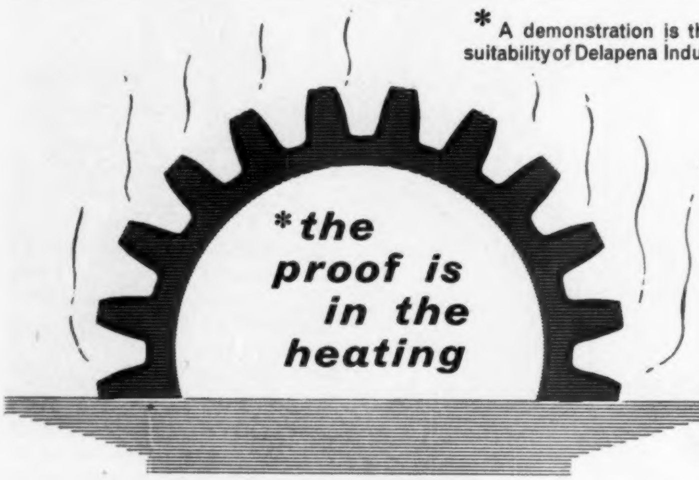
LAYSTALL ENGINEERING Co. Ltd.

53 Great Suffolk Street, London, S.E.1 *Telephone: WATerloo 6141*

tall Laystall Laystall Laystall Laystall La

---

* A demonstration is the best method of proving to your satisfaction the suitability of Delapena Induction Heating equipment for your own specific needs.



With this in mind our unique Applications Department offers you demonstrations of the many advantages of our patented induction heating process. For example, gear hardening can be made a production line process; manufacturing costs can be reduced by the elimination of expensive grinding operations; tooth profile can be finally hardened with the minimum of tooth "shape-change", ensuring a quieter and longer-lasting gear. These are but a few of the advantages offered to you by Delapena Heat Induction equipment. Why not come and see for yourself? We'll prove it!

Delapena

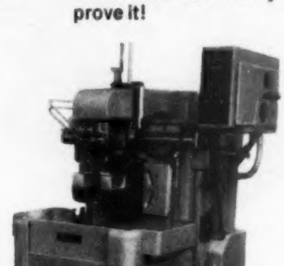
induction heating

DELAPENA & SON LIMITED

Manufacturers of Induction Heating and Precision Honing Equipment

TEWKESBURY ROAD, CHELTENHAM, GLOS.

Telephone: CHELTENHAM 56341/6. Telex 43354. Telegrams: Delapena, Cheltenham.



This fully automatic machine handles gears within a range of 1½" to 26" diameter, 2 to 10 diametrical pitch, face widths up to 8", and spur and helical gears up to 30°.

For a wonderfully smooth drive...**Holroyd** Worm Gears

Did you know that all Holroyd worm gears are made in such a manner as to give some allowance for the inevitable deflection of bearings and gear housing? This results in an improvement in performance because the gears are then working correctly in the loaded position. We are able to do this by a technique of manufacture which gives precise control over the tooth marking.

In certain cases we go further than this and make the gears so that they have some latitude in assembly without impairing the efficiency. This is particularly valuable where the gears are difficult of access for adjustment during assembly.

Another point—Holroyd worm gears are made, if required, right down to 1/1 ratio as an everyday product—we have a special plant for such gears.

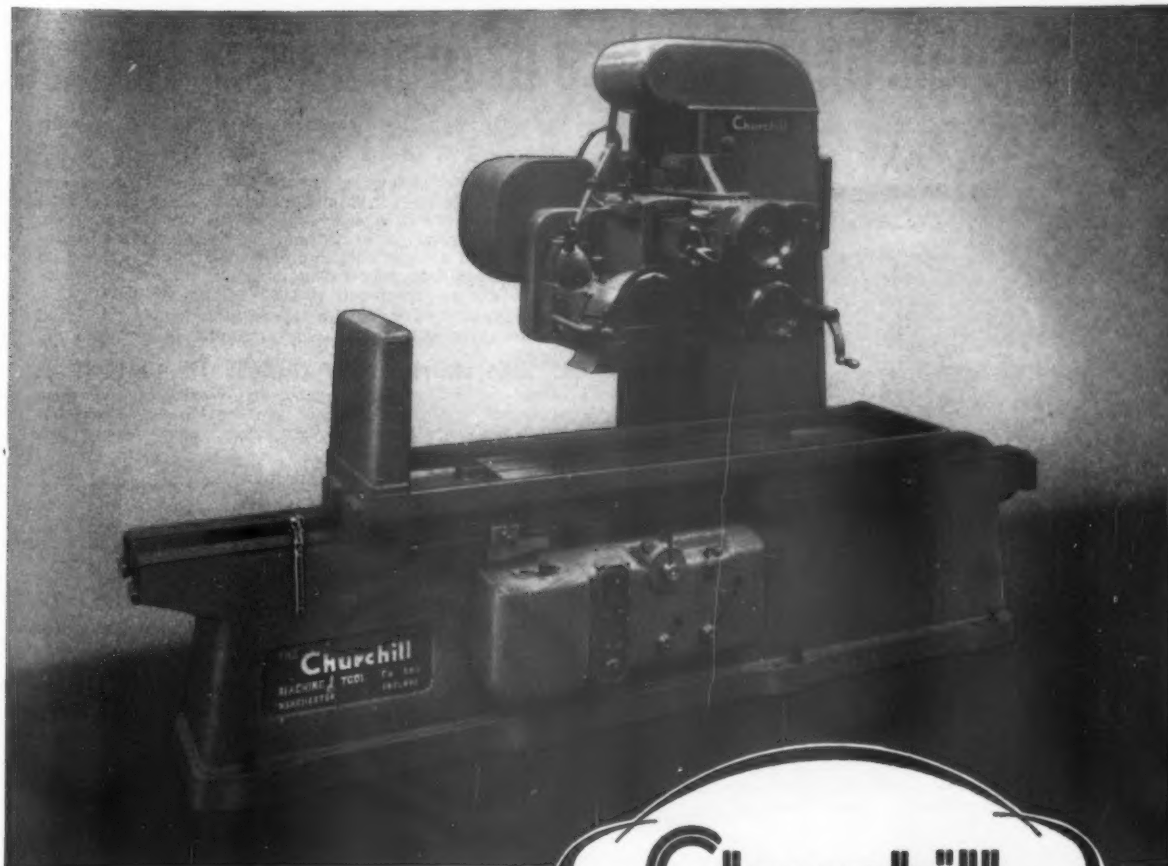
And don't forget that Holroyd worm gears around 1/1 or 2/1 ratio will carry several times the load which can be put through a pair of straight faced spiral gears of the same dimensions, and will work with an efficiency of the order of 97 per cent.

Have a word with **Holroyd**

John Holroyd & Co. Ltd., Milnrow, Lancashire

90 YEARS OF GEARS

CRC 194



OSD

OPEN-SIDE SURFACE GRINDING MACHINE

This heavy duty Horizontal Spindle Surface Grinder fully meets modern requirements for a machine capable of highly accurate work at maximum production rates. Available in three sizes with work table capacities of 30″ × 15″, 48″ × 15″ and 72″ × 15″.

Designed for heavy duty and continuous high speed precision working.

Electronically controlled intermittent cross feed. Provision for accurate reversal when grinding recessed faces.

Variable automatic vertical feed with pre-set automatic cut-out.

Hydraulic table traverse up to 100 feet per minute.

Table traverse ways automatically lubricated from oil supply independent of hydraulic system.

Permanently protected precision ground slideways.

Electrically driven slow cross traverse for wheel truing.

Grinding wheel spindle electrically interlocked against starting until lubricating pump is running.

THE CHURCHILL MACHINE TOOL CO. LTD., BROADHEATH, nr. MANCHESTER
Telephone: Altrincham 3262. *Telegrams:* Churchale, Manchester

Export Sales Organisation: Associated British Machine Tool Makers Ltd., London, Branches and Agents

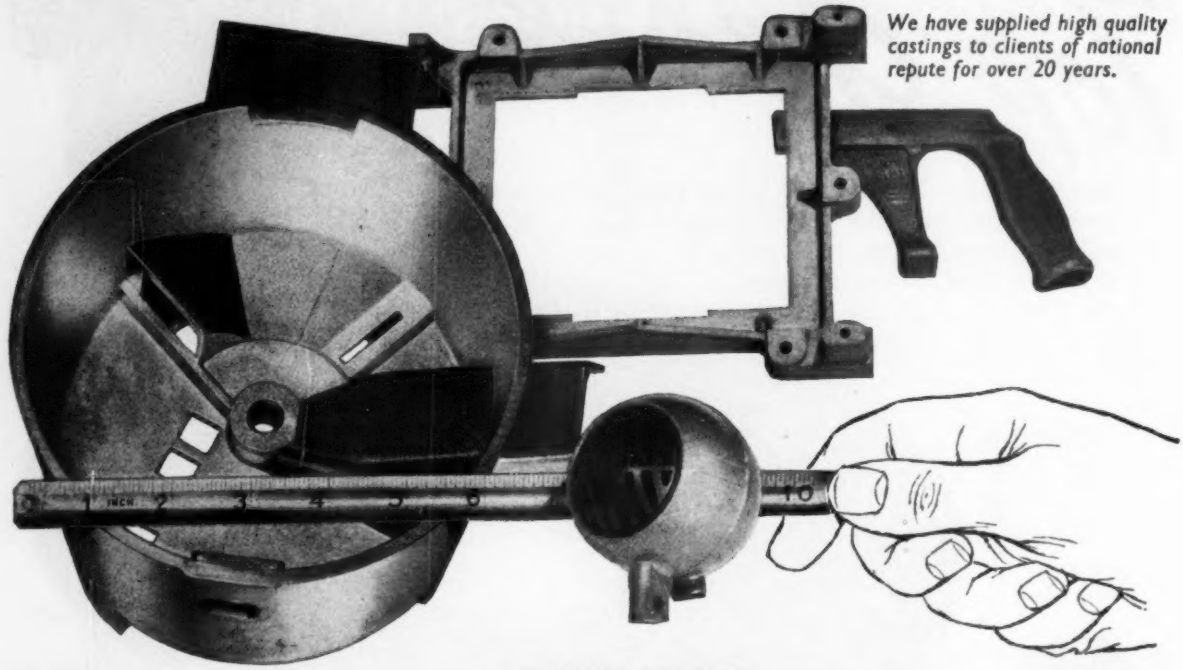
Home Selling Agents: Charles Churchill & Co. Ltd., Birmingham and Branches

PRECISION *plus* PRODUCTION

C663-1A

RELIABILITY FROM START TO FINISH

We have supplied high quality castings to clients of national repute for over 20 years.



RAWLINGS ***manufacturing company limited***

106-108 BEDFORD HILL, BALHAM, LONDON, S.W.12


VAUXHALL . . . an internationally illustrious name in the motor industry—and for accurate, economic production of many components, Vauxhall Motors Ltd. have installed Newall Grinding Machines.
NEWALL
MODEL LA
CYLINDRICAL GRINDER
Finish grind of the bearing diameters on this main driving pinion was a single operation with twin wheels—an example of the many applications for increased productivity obtainable with the
ILLUSTRATED BROCHURE AND FULL DETAILS SUPPLIED ON REQUEST TO:—
NEWALL GROUP SALES LIMITED
PETERBOROUGH
TELEPHONE 3227-8-9

we don't cast ...

Lack of appreciation has never been one of our worries. **GF** Malleable Iron earns praise—and repeat orders—everywhere. It combines the perfect castability of iron with mechanical properties comparable to those of steel. Please ask us to send you some facts and figures.

we cast GF malleable iron

GF *Malleable Iron Castings can be supplied self-colour as cast, varnished or hot-dip galvanized for extra corrosion resistance.*

GF MALLEABLE CASTINGS

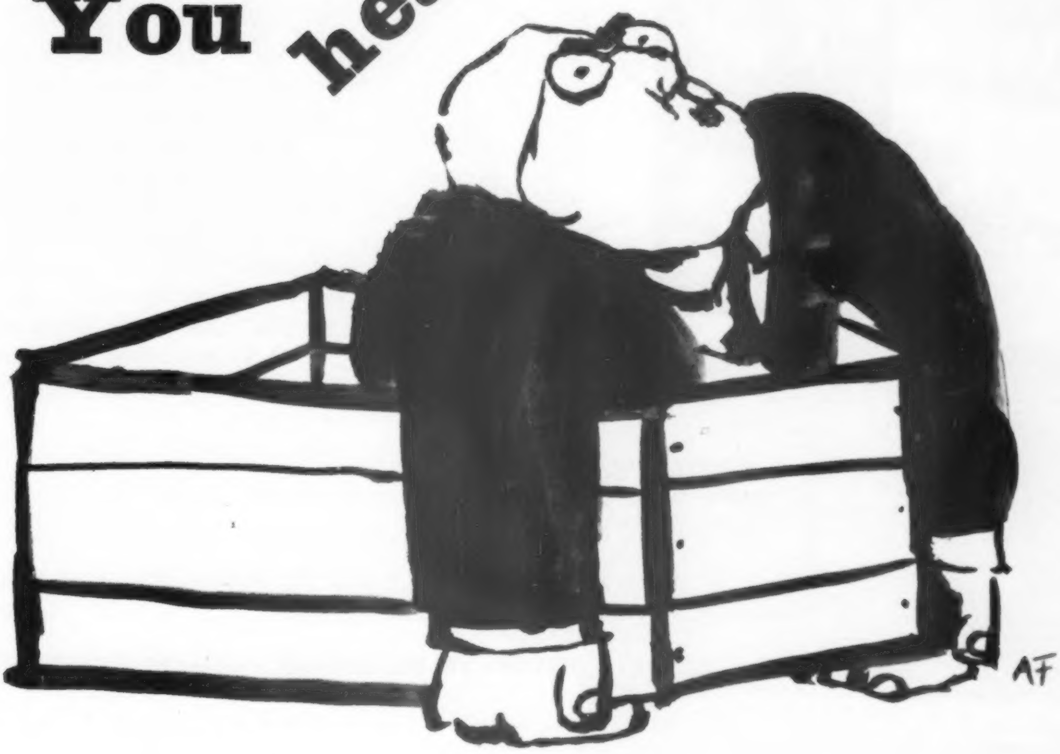
BRITANNIA IRON & STEEL WORKS LIMITED

A member of the George Fischer Group (Switzerland)

BEDFORD Telephone : Bedford 67261 **ENGLAND**

Broadway/bisl

You heave ho!



Q: *What do with drunken sailor?*

Simple! Scuppers. Hose-pipe on him. Long boat till sober. Never fails.

Q: *What do with sand, gravel, rock, rubbish, ready-mixed concrete, aggregate, ballast, tarmac, clinkers, coal, cobblestones, beach boulders, etc. etc.? How carry? How unload? No answer? . . . Come, now.*

Know answer! Telehoist tippers. Trucks long, short, trucks squat, lorries, dumpers, transporters, all fitted Telehoist tipping gear. Full marks.

Days of yore, brute force, muddy ignorance. Shovels and sweat. Swear-words. Nowadays, Telehoist. You pull lever. Way, hey, *up* she rises . . . . .

Telehoist tipping telequipment. Televers. Teleloaders. Highly telefficient. Sturdily teletechnical. Links . . . Scow ends . . . Telescopic rams (think of that!) . . .

Telehoist Limited one of the Wilmot Breeden companies? Correct. How did you guess?

WILMOT BREEDEN are at Birmingham:

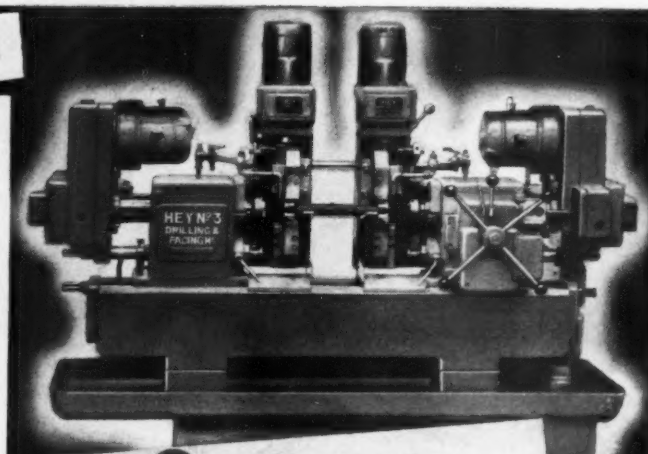
also at London, Manchester, Bridgwater, Glasgow, Melbourne, Toronto.

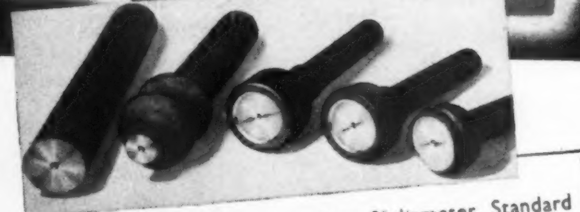
130 SHAFTS FACED AND CENTRED PER HOUR

Facing $\frac{1}{8}''$ off each end and drilling $\frac{7}{16}''$ centres in $2\frac{1}{2}''$ diameter Electric Motor Shafts in a floor to floor time of 27 seconds, is typical of the high production which can be achieved on the —

HEY No. 3 DOUBLE ENDED CENTRING & FACING MACHINE

- *Perfect alignment of centres*
- *True faces and accurate lengths*
- *Turned finish on faces*
- *Eliminates subsequent facing down to centres or recentring*





Faces 3" diameter. Standard Vices have maximum bar capacity of $6\frac{1}{2}''$ diameter. Minimum length handled 6". Standard bed lengths to take work up to 24", 48" or 72" long.

We also manufacture Rotary Cam and Profile Milling Machines, Short Thread Milling Machines, Multiple Drilling Heads and Machines, Tapping Machines, Gear Tooth Rounding Machines, Special Machine Tools for High Production.

HEY ENGINEERING CO. LTD.
COVENTRY PHONE: COVENTRY 88641

NRP 1522

Worm Drive HOSE CLIP

AGS 1000

Our 100 years presswork experience has enabled us to produce a clip with all the tenacity of the Bulldog

Immediate delivery of all Standard sizes from stock

Sample and price list from Dept. A

HERBERT TERRY & SONS LTD., *Spring Specialists*, **REDDITCH, WORCS**

But press operators need Udal protection

A piece-work operator whose output is reduced by slow guard operation is a frustrated person, and a frustrated person is in constant danger. For greater safety and more production you should ask UDAL about the famous 'Fastrip' synchronized guards, worked by compressed air and timed to a split second. Details will gladly be sent on request.

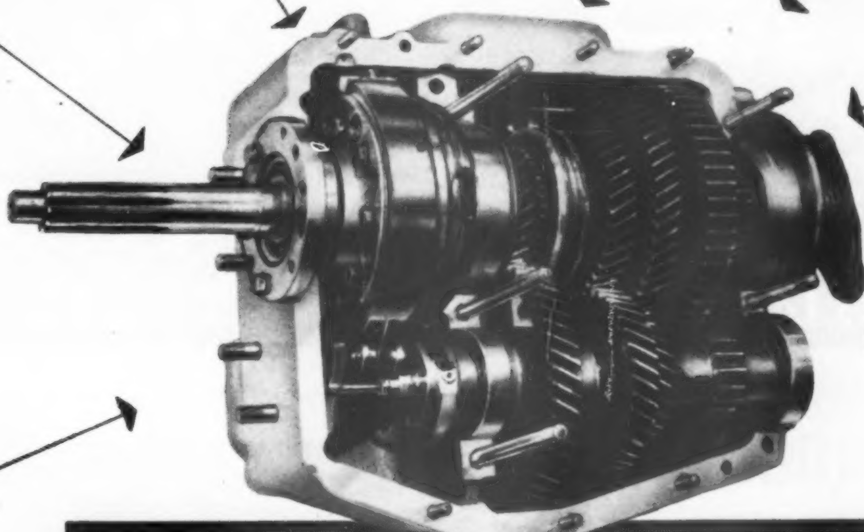
J. P. UDAL LIMITED
INTERLOCK WORKS
COURT ROAD · BIRMINGHAM 12
Telephone: CALthorpe 3114

Udal *PRESS GUARDS*

FEATURING

THE NEW

Moss Gear Box



NOW AVAILABLE FOR

6 OR 8 SPEED

Inclusive of Overdrive

Incorporating fingertip control

for double speed changing

without declutching

MOSS GEARS

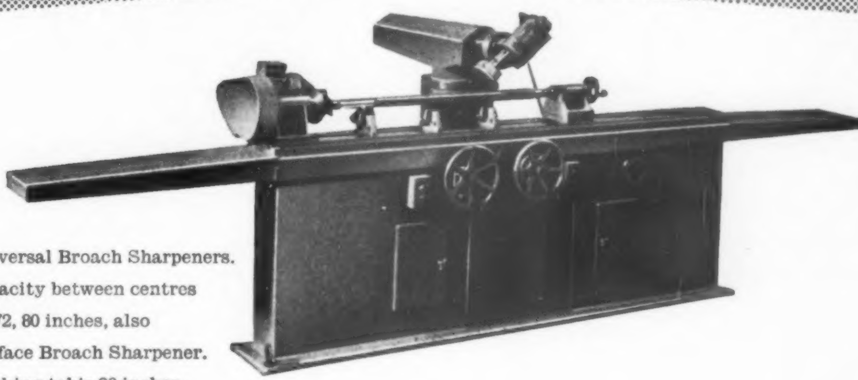
THE MOSS GEAR CO. LTD.

CROWN WORKS, TYBURN, BIRMINGHAM, 24

Telephone: ERDington 1661/6 Telegrams: 'Mosgear, Birmingham.'

come to

LAPOINTE for better broaching



Universal Broach Sharpeners.
Capacity between centres
60, 72, 80 inches, also
Surface Broach Sharpener.
Working table 36 inches.

Horizontal Hydraulic
Broaching Machines.
Capacity: 2½-50 tons.
Stroke: 30-78 inches.

British Made

The Lapointe Machine Tool Co Ltd

Otterspool Watford-by-Pass Watford Herts
Telephone Watford 31711/2/3/4 Cables Lapointe Watford
Also The Lapointe Machine Tool Company Hudson Mass. USA


For smooth and silent running . . .
MORSE timing chains

Follsain-Wycliffe

FOUNDRIES LTD

The

SPECIALIST FOUNDRY

for

BLACKHEART MALLEABLE IRON

and

HEAT & ABRASION RESISTING ALLOY CASTINGS

for

Automobile and Commercial Vehicles,
Gas Electricity and Steel Undertakings
Mining and Quarrying Plant
Cement, Tile Bricks and Pipe Works
Heat Treatment Plants
together with many others

CASTINGS SUPPLIED AS CAST OR FULLY MACHINED

Manufacturers of the
PULMAC PULVERISING MILLS
for fine grinding

FOLLSAIN-WYCLIFFE FOUNDRIES LTD
LUTTERWORTH NR. RUGBY
Tel.: Lutterworth 10, 60 and 152
Grams.: 'Wycliffe' Lutterworth

582

Still the best straight oil *

SWIFT

when cutting tough steels

No matter the application, SWIFT oil in its many forms, is a blessing when the tougher steels are tooled. Its sulphur-activated base prevents localised welding of chips to the tool face and materially assists the attainment of high output schedules.

There are SWIFT grades specially adapted to automatics, gear cutting, thread milling, form grinding, broaching and honing operations. And if you wish to cut non-ferrous materials on the same machines as steel, without changing the oil, the unique SWIFT S.S. series is your logical choice.

By asking for Publication SP.173—on your business letterhead please—you will receive up-to-date information on FLETCHER MILLER cutting fluids.

* *one of the*

FLETCHER MILLER

cutting fluids

FLETCHER MILLER LTD., CHESHIRE.
Telephone: HYDE 3471 (5 LINES) *Telegrams:* EMULSION, HYDE

CF 117

Classified Advertisements

RATE 4d. PER WORD · MINIMUM 4/-

Each paragraph charged separately. Box number 5 words plus 1/-

Advertisements for the April 1959 issue should be to hand not later than first post 23rd March

(No responsibility accepted for errors)

FOR SALE

100 BAYS of brand new adjustable Steel Shelving, 72 in. high × 34 in. wide × 12 in. deep, stove enamelled dark green, sent unassembled, six-shelf bay, £3 15s. 0d. Sample delivered free. Quantity discounts. N. C. Brown Ltd., Eagle Steelworks, Heywood, Lancs. Tel. 69018. [5675

PLANT FOR SALE

SEEST Machines, new and unused, held for customer who has failed to complete:

CRANKSHAFT Grinder, Type V, 16" × 54"; cost £1,195.

TWIN Head Connecting Rod Borer; cost £548.

SELF-CENTRING Line Borer, 60" × 24" × 4"; cost £789.

ACCEPT £1,500 for the three. Valcrad Engineering Co., 1-3 London Street, Chertsey. [5681

PATENTS

THE Proprietors of British Patent No. 722144, for an "Improved Spring-Powered Starter for Internal Combustion Engines," desire to enter into negotiations with a firm or firms for the sale of the patent, or for the grant of licences thereunder. Further particulars may be obtained from Marks & Clerk, 57 and 58 Lincoln's Inn Fields, London, W.C.2. [5679

PATENT No. 764435, "Semi-Trailer Hitch," for sale or licence. Apply:—Chatwin & Company, Chartered Patent Agents, 253 Gray's Inn Road, London, W.C.1. [5682

London: W. Kelway-Bamber & Co. Ltd., 70 Victoria St. S.W.1 Tel: Abbey 6860
N. E. Coast: Fasteners Ltd., 2 Hall St., Barnard Castle, County Durham. Tel: Barnard Castle 3172

Samuel Marsden & SON LTD

ALTRINCHAM STREET, MANCHESTER, 1.

dmSM44

PATENTS

THE Proprietor of British Patent No. 700846, entitled "Valve Seat Insert Construction for Internal Combustion Engine," offers same for licence or otherwise to ensure practical working in Great Britain. Enquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A. [5680

A Multiplication

precision sum

● For automatic and capstan precision parts—in any metal—to your own specifications . . . *consult the specialist machinists.*

I.F.V., D.A.I., D.I.Arm., A.R.B. Fully Approved.

REPETITION PARTS *from the* **BAR** *by* . . . .

Telephone: Broadwell 1115 (4 lines) and 1757

M C L

M.C.L. & REPETITION LTD.

POOL LANE · LANGLEY · BIRMINGHAM

SITUATIONS VACANT

PATENT Examiners and Patent Officers. Pensionable posts for men or women for scientific, technical and legal work on Patent applications. Age at least 21 and under 28, with extension for regular Forces Service and Overseas Civil Service. Qualifications: normally first or second class honours degree in physics, chemistry, engineering or mathematics, or equivalent attainment, or professional qualification, e.g. A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.R.I.C. London salary (men) £635-£1,410; provision for starting pay above minimum. Promotion prospects. Write Civil Service Commission, 17 North Audley Street, London, W.1, for application form, quoting S128/59. [5677

THE ROVER COMPANY (Engineering Dept.) requires Technical Assistants for interesting work on high quality passenger cars. Applicants should have some experience of this type of work and technical qualifications equivalent to H.N.C. Salary in accordance with experience and qualifications. The aim is to secure men who are able to follow through specific investigations on their own initiative without undue supervision. Please write with full particulars to the Labour Manager, The Rover Co. Ltd., Lode Lane, Solihull, Warwicks. [5676

REQUIRED by Diesel Engine Manufacturers, a Senior Sales Engineer with extensive experience and contacts in the heavy vehicle industry. Applicants are requested to give precise details of their experience. A good salary will be paid to the right man. Box No. 2171, c/o Automobile Engineer. [5678

TUITION

A.M.I.M.I., City & Guilds, A.M.I.Mech.E., etc., on "No Pass-No Fee" terms. Over 95% successes. For details of Exams and Courses in all branches of Auto, Diesel, Aero, Mechanical Eng., etc., write for 148-page Handbook—Free. B.I.E.T. (Dept. 643), 29 Wright's Lane, London, W.8. [5672

COTTON BAGS

FOR SPARE PARTS, Etc.

Walter H. Feltham & Son Ltd

Imperial Works, Tower Bridge Road
Telephone: HOP 1784 LONDON, S.E.1

PARKER PACKING

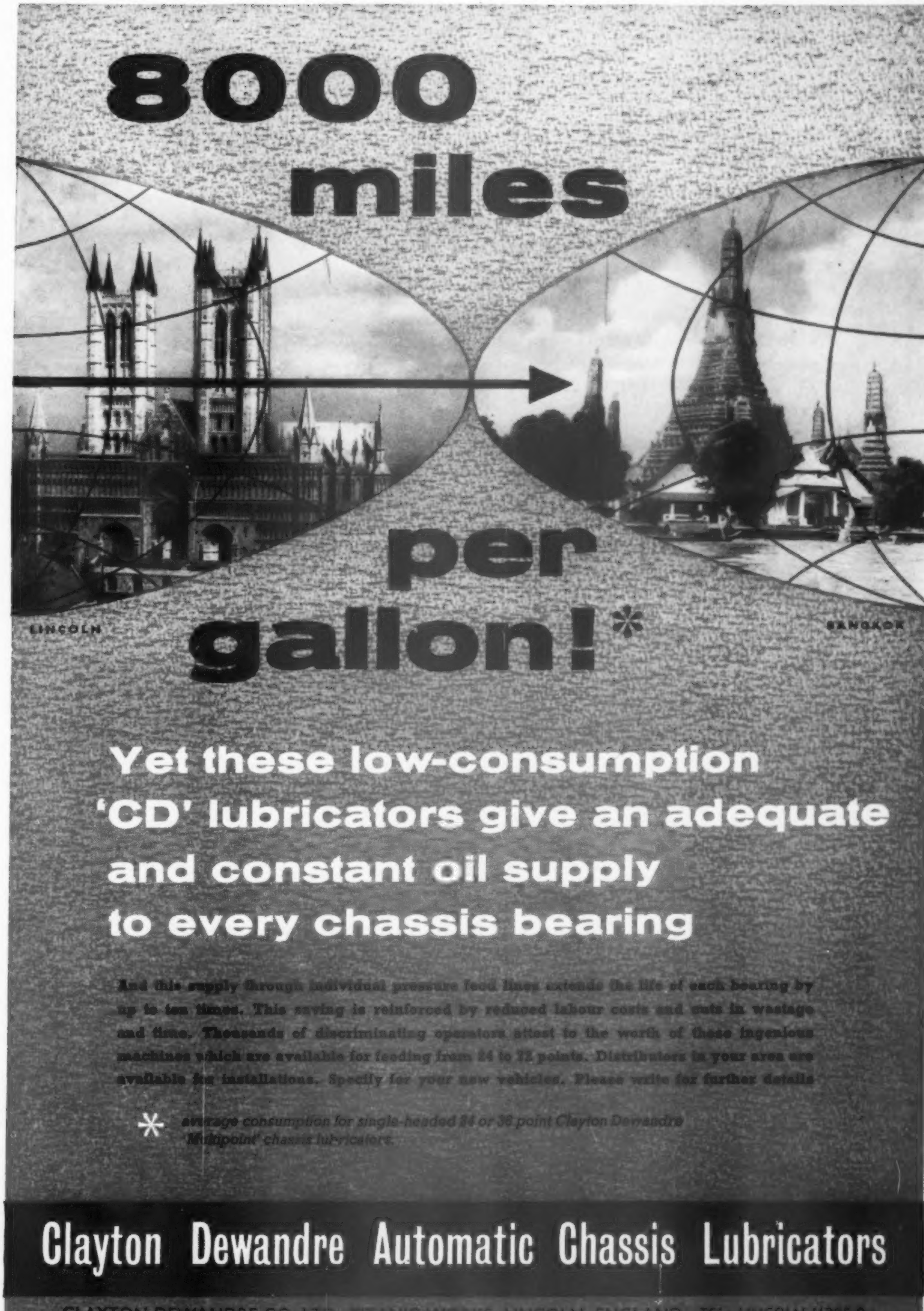
CARS · TRACTORS · LORRIES
TRANSPORTED · PACKED
STORED AND SHIPPED

Our 6-acre waterside wharves cope with all types of vehicle and machinery. A large carton and wrapping section is at your disposal giving express turn-round on large and small contracts.

THE PARKER PACKING CO. LTD.,
VICTORIA WHARF, GROVE STREET,
DEPTFORD, S.E.8.
Telephone: Tideway 6511.

INDEX TO ADVERTISEMENTS

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by James Cond Ltd., Charlotte Street, Birmingham 3. "Automobile Engineer" can be obtained abroad from the following: AUSTRALIA & NEW ZEALAND: Gordon & Gotch Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd.; Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency Ltd.; Wm. Dawson & Sons (S.A.) Ltd. UNITED STATES: Eastern News Co. Entered as Second Class Matter at the New York, U.S.A., Post Office.


8000 miles per gallon!*
LINCOLN
BANGKOK
Yet these low-consumption 'CD' lubricators give an adequate and constant oil supply to every chassis bearing
And this supply through individual pressure feed lines extends the life of each bearing by up to ten times. This saving is reinforced by reduced labour costs and cuts in wastage and time. Thousands of discriminating operators attest to the worth of these ingenious machines which are available for feeding from 24 to 72 points. Distributors in your area are available for installations. Specify for your new vehicles. Please write for further details
* average consumption for single-headed 24 or 36 point Clayton Dewandre 'Multipoint' chassis lubricators.
Clayton Dewandre Automatic Chassis Lubricators
CLAYTON DEWANDRE CO. LTD., TITANIC WORKS, LINCOLN, ENGLAND. TEL: LINCOLN 11305-9